WEATHER AND CIRCULATION OF FEBRUARY 1957 [1]

ANOTHER FEBRUARY WITH A PRONOUNCED INDEX CYCLE AND TEMPERATURE REVERSAL OVER THE UNITED STATES

C. M. WOFFINDEN

Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

1. HIGHLIGHTS

During February 1957 the principal seat of blocking shifted from the Gulf of Alaska to the areas of Baffin Bay and Novaya Zemlya. This displacement was associated with an index cycle characteristic of February and with a distinct warming trend in the United States.

[1] See Charts I-XVII following p. 68 for analyzed climatological data for the month.

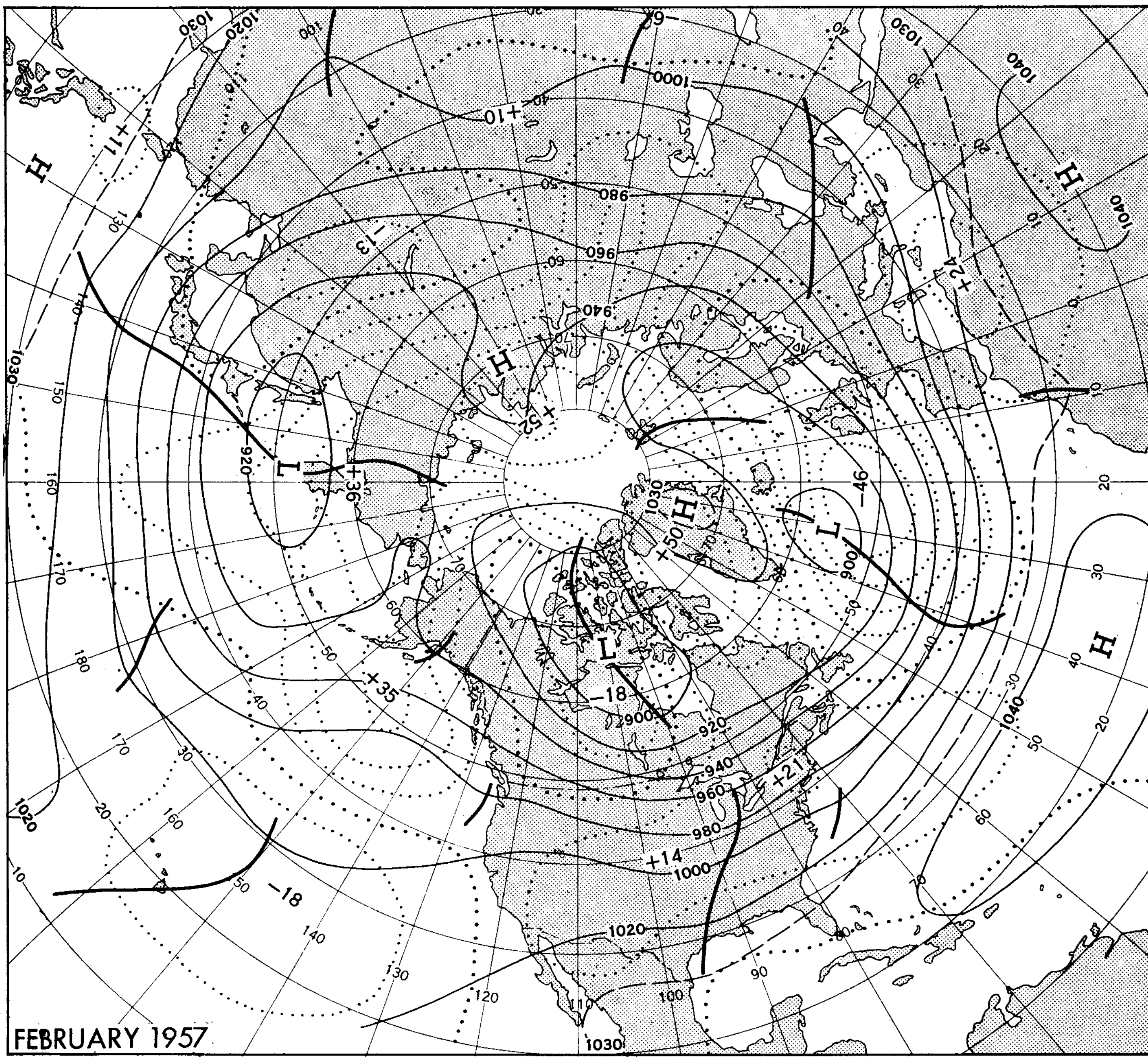


FIGURE 1.—Mean 700-mb. height contours (solid) and departures from normal (dotted) (both in tens of feet) for February 1957. Extensive areas of positive anomaly at higher latitudes and negative at lower latitudes were typical low-index circulation patterns. The seat of blocking shifted during the month from its January location in the Gulf of Alaska to northern Siberia and Baffin Bay.

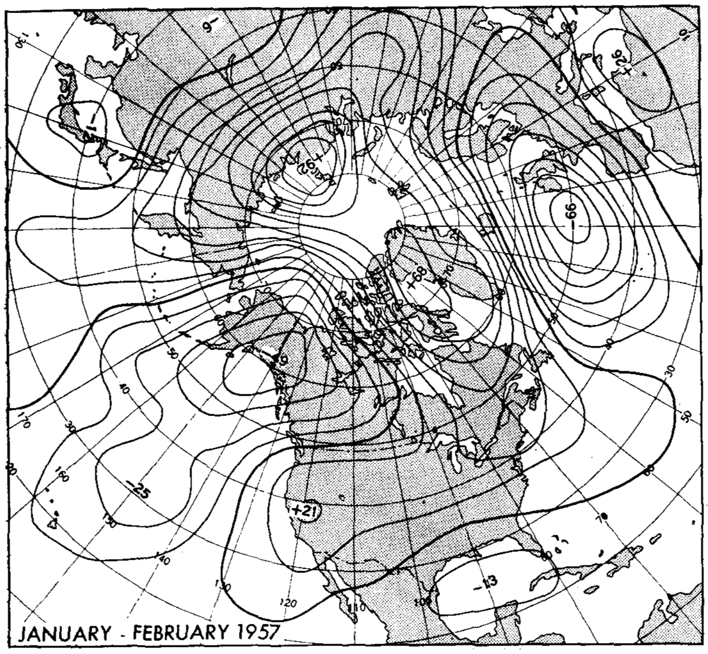


FIGURE 2.—Difference between the monthly mean 700-mb. height departures from normal for January and February 1957 (in tens of feet). The major changes were incident to the shift in locale of blocking from the Gulf of Alaska to northern Siberia and Baffin Bay. Greatly increased cyclonic development in the eastern Atlantic flooded Europe with mild maritime air.

2. GENERAL CIRCULATION

The most striking aspect of the mean monthly 700-mb. circulation (fig. 1) was the preponderance of above normal heights in polar latitudes. Of the area north of 60° N., only the troughs in the northwestern Canadian provinces and Norwegian Sea were sufficiently pronounced to produce below normal heights.

In January [10] the blocking anticyclone was firmly entrenched in the Gulf of Alaska, and this regime extended its domination into early February. However, as the month progressed, the influence of blocking was felt with increasing intensity over far northern Siberia and northeastern North America, while heights fell in the Gulf of Alaska. The resulting change in circulation from January to February is illustrated in figure 2. Though the shift began early in February, it did not become firmly established until the latter half of the month, as illustrated in figure 3. Thus, the two regimes were competing for control during the period, and both are therefore reflected in the mean pattern (fig. 1). For this reason as many as four relatively large positive DN centers appear in northern latitudes, a rather rare occurrence on mean monthly charts. The +350-ft. center in the Gulf of Alaska and the +360-ft. center near Kamchatka were thus representative of the first portion of the month, and the other two centers (+520 ft. and +500 ft. over Baffin Bay and the Laptev Sea) were representative of the latter portion. These features will be discussed further in section 4.

With above normal heights firmly entrenched at high latitudes, cyclonic centers, with the exception of the Canadian depression, were limited mainly to southerly latitudes. Thus the Icelandic Low, though intense (−460 ft.), was depressed to the south of its normal position and produced a flow of mild maritime air into Europe (fig. 1).

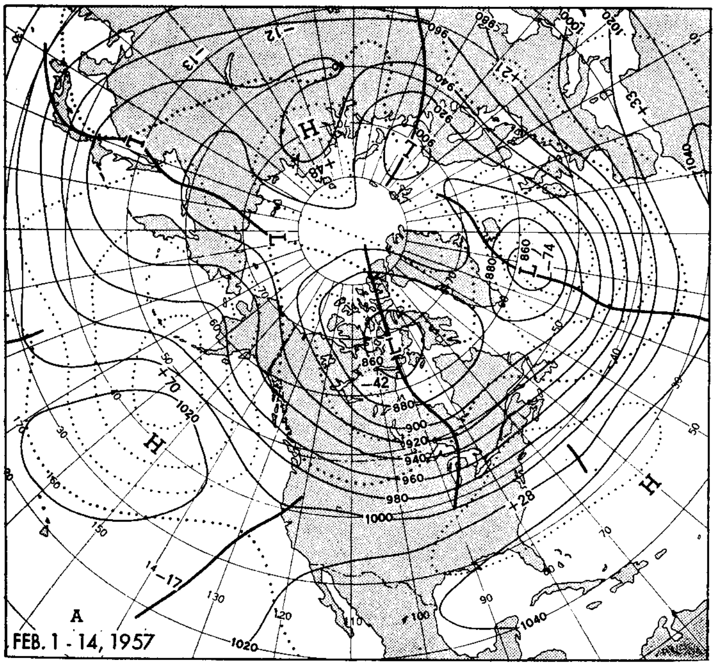
In the Pacific, the very long wavelength at middle latitudes (figs. 1 and 3A) proved unstable, and a new full-latitude trough with strong negative tilt developed during the latter half-month (fig. 3B) from the Hawaiian Islands northwestward. Its southern portion was intense, with a negative anomaly of 450 feet centered just to the north of Hawaii and effected a marked change in rainfall regime in those Islands. Particularly striking in this connection is the fall center of 940 ft. (fig. 3C) in the east-central Pacific associated with this change.

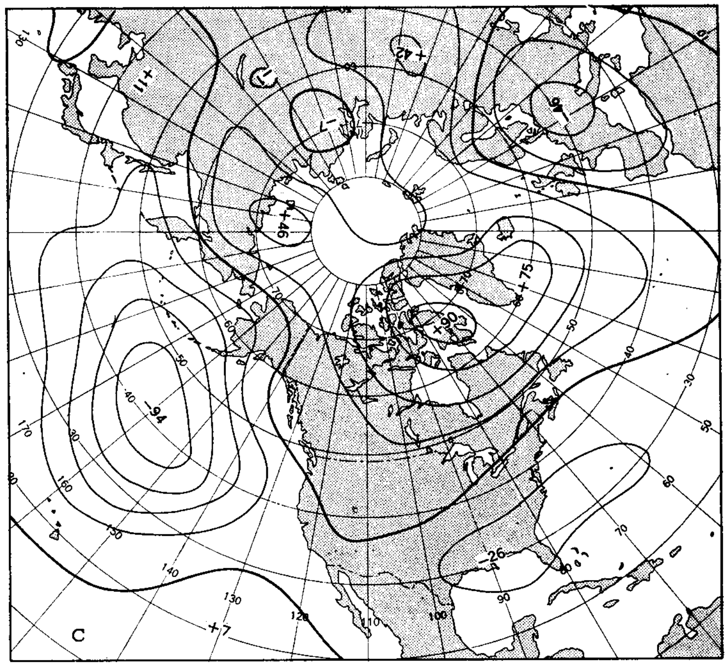
The wind speed profiles further illustrate the pattern of change. Figure 4a shows the tendency of mid-latitude westerlies to increase at the expense of the polar westerlies from January to February. As the month progressed the subtropical westerlies strengthened appreciably, with middle-latitude westerly flow diminishing. This is rather strikingly illustrated in figure 4b, in which the westerlies decelerated at middle latitudes and increased only at low latitudes. Expansion of the circumpolar vortex in this manner has been described [6, 13] as often accompanying an index cycle.

3. INDEX CYCLE

Two index cycles of rather large amplitude have already been described in previous articles in this series treating this winter [3, 10], and the oscillation of this February, therefore, constitutes the third such occurrence. However, it differed in one rather important aspect from its January counterpart, namely, that the westerlies suffered a southward displacement, whereas in January they were shifted northward into the polar basin. To illustrate this interesting variation, the graph of figure 5 has been prepared. Note that in January the polar index (55° N.–70° N.) attained its maximum value (over 10 m. p. s.) and the temperate-latitude index (35° N.–55° N.) its minimum, almost simultaneously. On the other hand, in February, flow in the polar basin reversed to easterly, and this time the subtropical westerlies (20° N.–35° N.) climbed to a maximum at the low point of the index cycle. This has been described [6, 13], as the more typical sequence of events accompanying index cycles in which the circumpolar vortex expands and the jet stream is displaced to lower latitudes. In this regard the January cycle was quite anomalous.

The index graph (fig. 5) shows that high index prevailed for the first, and low index for the latter portion of the month, further illustrating the month's non-homogeneity. That this is typical of February is illustrated by the fact that five of six authors of previous February articles in this series (starting 1950) found it convenient to divide the month into two parts. This month adds a seventh instance to this list, and the circulation changes within





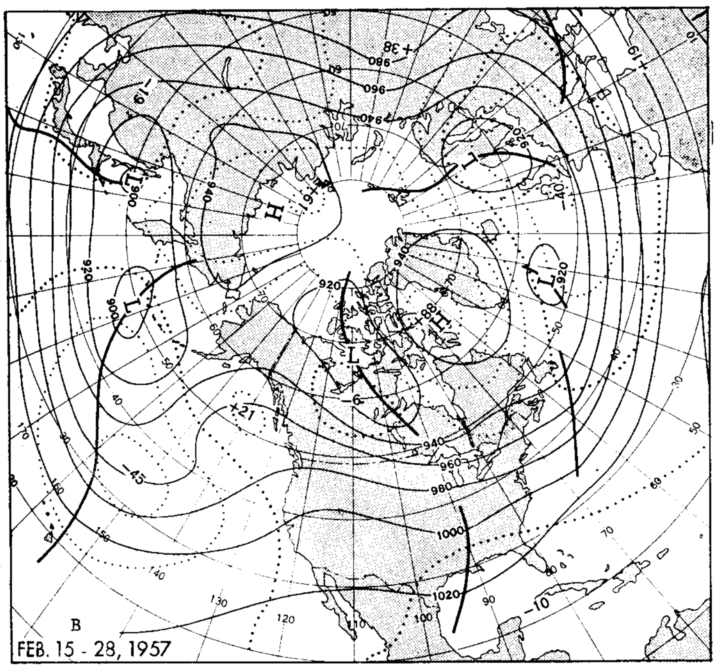


FIGURE 3.—Fifteen-day mean 700-mb. height contours (solid lines) and departures from normal (dotted lines) (both in tens of feet) for the two halves of February 1957. Part C shows the difference in height between the two periods. The January pattern, which was characterized by pronounced blocking in northern latitudes of the Pacific, carried over into February, so that most of the January-February change occurred during the second portion of the month. Note the development of the negatively tilted trough to the north of the Hawaiian Islands and the filling of the Canadian depression as blocking assumed control over northeastern Canada.

the month can best be considered by returning to a discussion of blocking, but considering its behavior this time in relation to 5-day mean periods.

4. THE BLOCKING

It has already been mentioned that blocking in the Gulf of Alaska carried over into February from the previous month. Figure 6A was prepared to study the history of this persistent feature. It traces the locus of the associated center of positive anomaly and amply illustrates its pre-eminence in the Gulf of Alaska during each week of January and into early February. The later positions however, are farther west and with a notable tendency to sink southward, a frequent prelude to weakening and splitting of such centers. This appears to have transpired and, at the time of the 5-day mean map centered on the 7th, one blocking surge is traceable westward to Kamchatka, while the original center weakened and continued on its southeastward course. On the mean map centered on the 14th, the original center seems to have amalgamated off the Washington-Oregon coast with a similar but retrograding center whose history is described in the next paragraph.

The second and perhaps more interesting blocking wave can be traced completely around the pole as shown in figure 6B. The following points are to be noted: 1. The block originated over Novaya Zemlya, and the first position shown is for the mean period centered January 31 with an anomaly value of +500 ft. The following week it retrograded in the well known discontinuous fashion [7], while the parent center diminished in intensity but remained in the same general locale. (Track not shown). 2. The next week it retrograded farther into the Davis Strait, where it attained maximum intensity about mid-month. Once again the blocking influence was transmitted westward, this time across Canada and

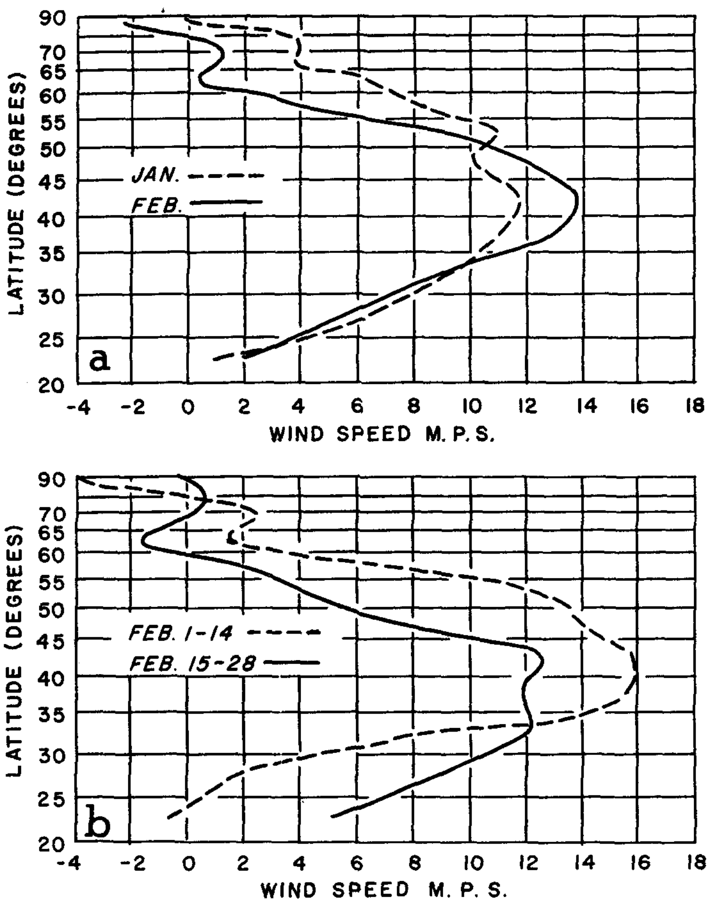


FIGURE 4.—Mean 700-mb. zonal wind speed profiles for the Western Hemisphere for (a) January and February 1957 and (b) February 1–14, and 15–28, 1957. The westerlies in the subtropics increased at the expense of first polar and then temperate westerlies.

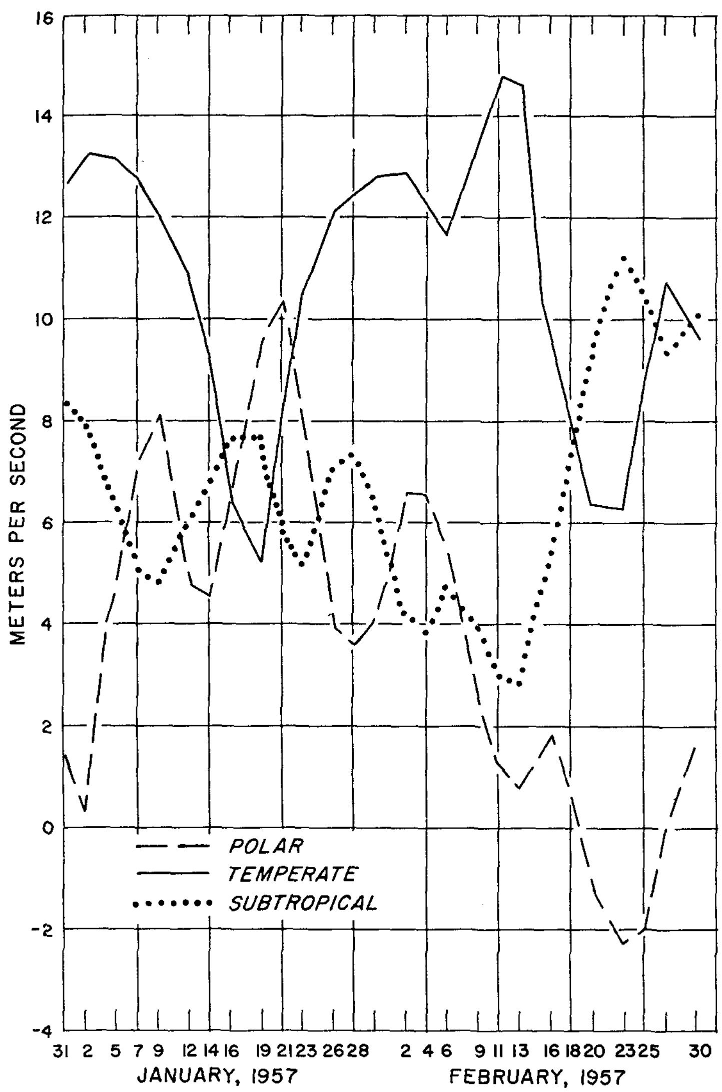


FIGURE 5.—Time variation during January and February 1957 of the 5-day mean values for subtropical (dotted), temperate (solid), and polar (dashed) westerlies (in meters per second, plotted on the last day of the period). The indices are computed for the Western Hemisphere and for the latitude belts 20°–35° N., 35°–55° N., and 55°–70° N., respectively. Two pronounced index cycles are in evidence, but that of January was accompanied by a poleward shift of the westerlies, while in February they were displaced equatorward.

into Alaska (centered on the 21st), while the original center wandered slowly northward into Baffin Bay and weakened. 3. The whole Alaskan anomaly center then retrograded rapidly in toto across northeastern Siberia and by month's-end had returned to its point of origin. For this portion of the track it behaved as a typical "high latitude" block [2]. 4. Of additional interest with respect to the Alaskan anomaly center is the ridge retrogression which followed a course from the western Atlantic across the southern United States. It seems to have made a contribution to the +510-ft. center which appeared off the coast of Washington on the mean chart centered on the 14th and later developed into the mature Alaskan blocking center previously described. From the position off the Washington coast, the anomaly center moved northwestward at a speed of about 200 miles per day, which is unusually fast for such large positive DN centers.

The short tenure of this blocking anticyclone in the Gulf of Alaska was very important with respect to repercussions on the weather downstream over the United States. The two 5-day mean maps one week apart (figs. 7A, 7B) illustrate this. At the time of the first chart (Feb. 14–18) the blocking High in the Davis Strait was near maximum intensity (central DN value +1,240 ft.), and the west coast ridge was rapidly developing. Note a long half wavelength between this ridge and the trough just off the United States east coast. The following week (fig. 7B), the principal blocking High proceeded rapidly westward to northeastern Siberia, heights fell rapidly in the Gulf of Alaska, and an intense depression with central value 1,050 ft. below normal appeared at middle latitudes in the eastern Pacific. The result was a complete alteration of the flow over the United States, with a rapid warming in the West. The continued stretching of the previously noted long wavelength over the United

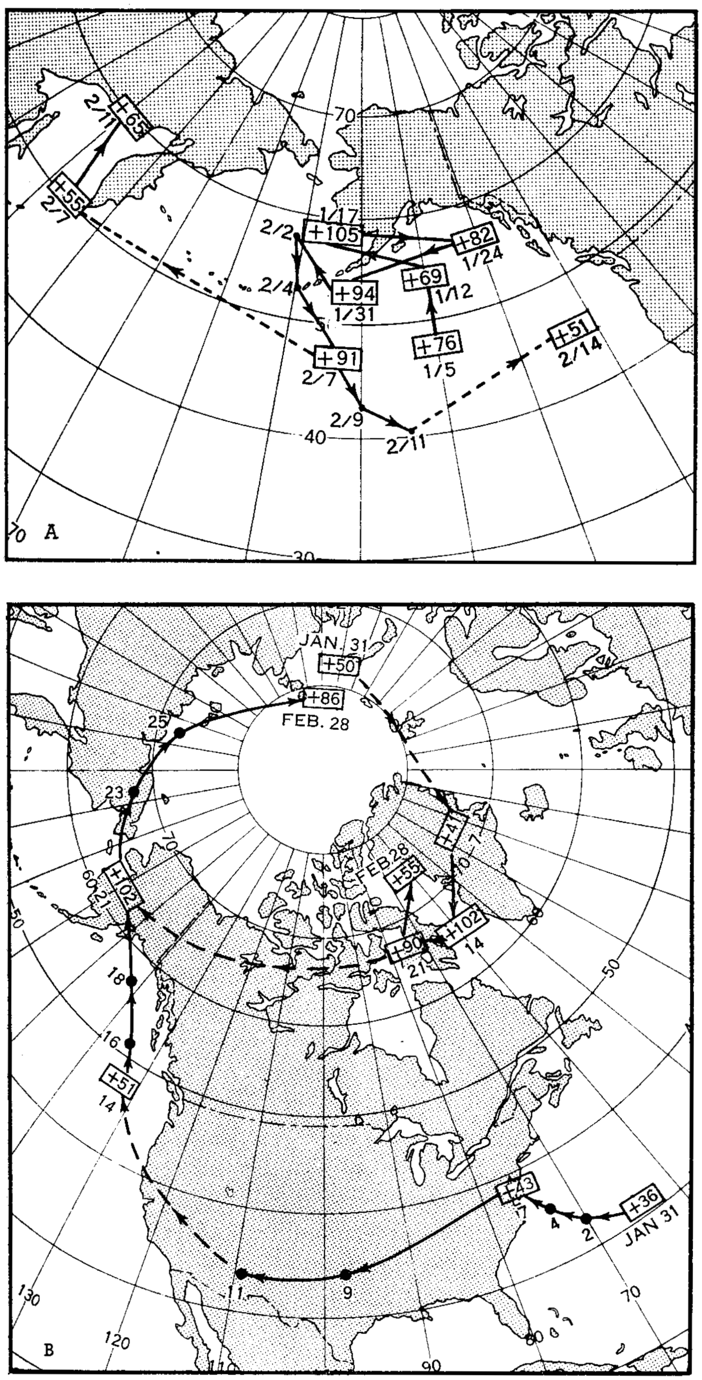


Figure 6.—Trajectories of selected centers of 5-day mean positive 700-mb. height anomaly for February 1957, dated at center of 5-day period. Intermediate positions, where necessary to illustrate continuity, are shown as dots. Dashed lines are used for discontinuous, and solid lines for bodily, movement of centers. The Gulf of Alaska was the principal seat of blocking during January, and this pattern carried over into the first week of February as shown in (a). However, prior to mid-month the center of positive anomaly shifted southward, weakened, and split into two surges, one of which retrograded in discontinuous fashion toward Kamchatka and the other proceeded eastward toward the Washington coast. In (b) it is possible to trace one blocking surge completely around the pole. Note the unusually rapid retrogression of the center from the Washington coast across Alaska and into the Laptev Sea.

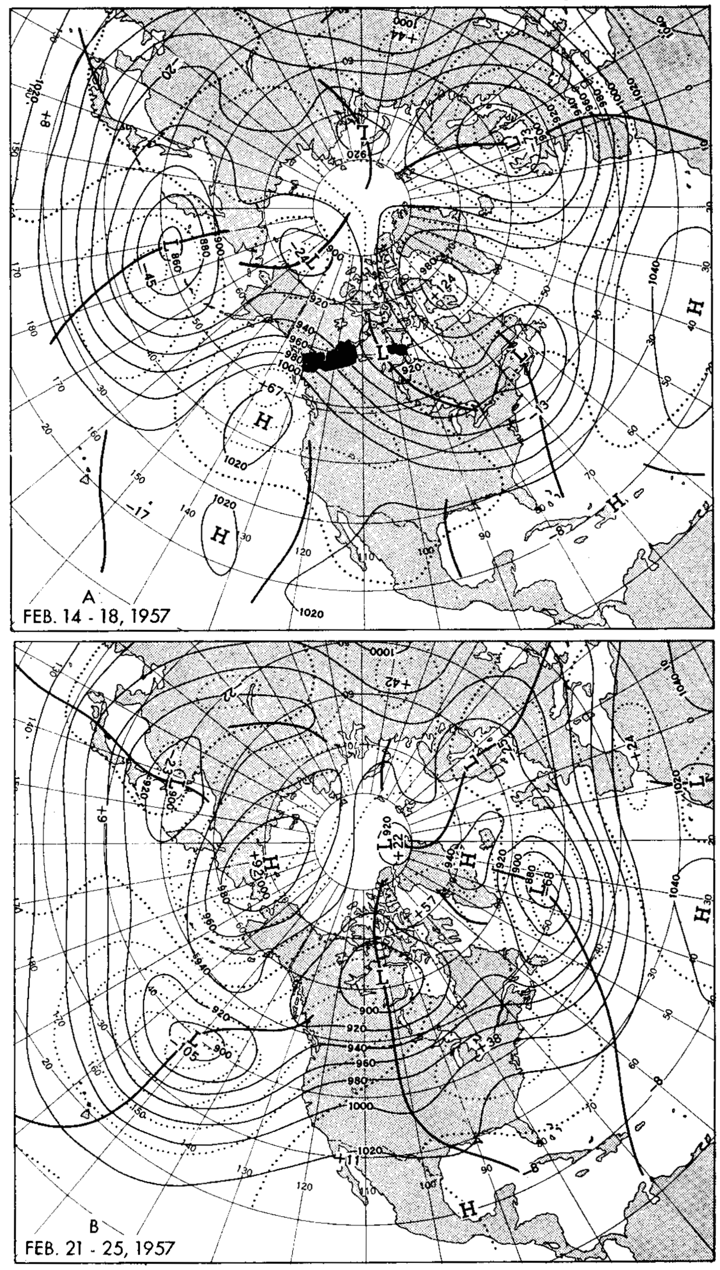


Figure 7.—Mean 700-mb. height (solid lines) and anomaly (dashed) (both in tens of feet) for the 5-day periods (A) February 14–18, and (B) February 21–25, 1957. During this time the blocking High retrograded rapidly across the Gulf of Alaska and into northeastern Siberia. An abrupt alteration of flow pattern took place over the western United States, as 700-mb. heights fell rapidly in the southern Gulf of Alaska resulting in a strong flux of warm air into the West. Note the development of a new trough along the eastern slopes of the Rockies in response to the long and expanding half wavelength between the Gulf of Alaska ridge and the trough off the east coast.

States resulted in a new trough development in the lee of the Rocky Mountains. Although this trough was weak, especially in a departure from normal sense, it was associated with the only pronounced outbreak of polar Canadian air during the month [11].

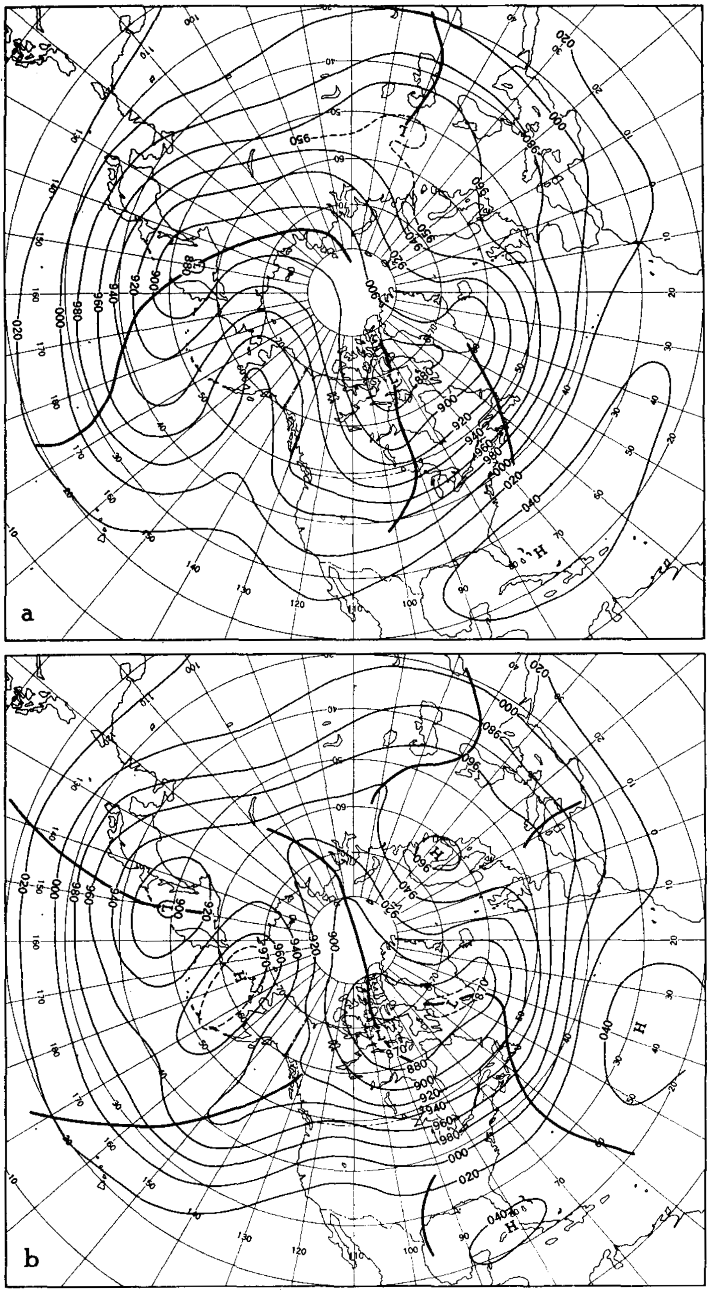


FIGURE 8.—(a) Composite chart (contours labeled in tens of feet) of five cases of 5-day mean 700-mb. maps in which a marked ridge overlay the Gulf of Alaksa just prior to retrogression. (b) Composite of the same cases after one week had elapsed. Resemblance to figure 7 is striking. The development of a new trough in the Gulf of Alaska resulted in a radical change in pattern over the United States.

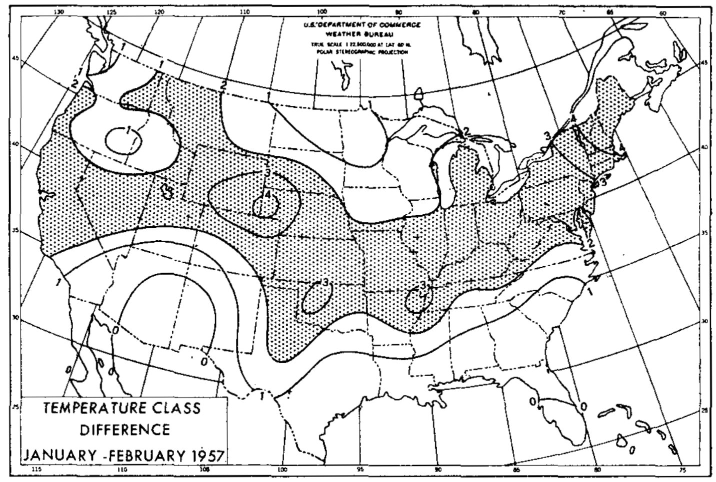


FIGURE 9.—Number of classes the anomaly of temperature changed from January to February 1957, with warming considered positive. The reversal from January is remarkable, with warming over almost all of the United States. Over a large belt through the central part of the country (stippled), a temperature increase of two classes or more occurred.

This type of development, in which a Gulf of Alaska depression develops in conjunction with the retrogression of blocking Highs, has been described by Namias and Clapp [7] and Winston [15]. On a previous occasion, the author prepared a composite chart of such cases selected from the Extended Forecast Section file of 5-day mean 700-mb. charts from January 1948 through January 1957. As a criterion for figure 8a, the five largest cases of positive anomaly in the Gulf of Alaska just prior to retrogression northwestward were selected. Figure 8b is a composite of the 5-day mean charts for the following week.

From the close correspondence between figures 7 and 8 it is evident that a similar evoluton occurred in this instance. The result was a complete reorientation of flow pattern over the United States, in response to the new trough which developed in the eastern Pacific. Apparently this is a characteristic form of behavior of the general circulation subsequent to retrogression of strong ridges originally present in the Gulf of Alaska.

5. TEMPERATURES IN THE UNITED STATES

February 1957 was an unusually warm month in the United States. Only in the extreme northwest were monthly mean temperatures cooler than normal, and these only slightly. The change from January was very marked, and in no area did it cool even by as much as one temperature class (out of five) (fig. 9). In fact, temperatures over a broad belt extending from coast to coast across central United States warmed by two classes or more, with four-class changes observed in the vicinity of Cheyenne, Wyo., and in northeastern New England.

The corresponding change in circulation pattern is best studied from figure 2. Of importance for temperature considerations are the following:

1. The falling away of the ridge in the Gulf of Alaska as the principal seat of blocking retreated from that area. In February this ridge was much weaker and farther west than its January counterpart, so that the air flow entering western North America was mainly of maritime rather than continental origin.

2. The increase in 700-mb. height values over the whole of the United States, except for areas immediately adjacent to the Gulf of Mexico.

TABLE 1.—*New records of mean monthly temperatures (° F.) for February*

Station	February 1957		Previous maximum	
	Temperature	Departure from normal	Temperature	Date
El Paso, Tex	57.6	+8.5	54.8	1907
Tucson, Ariz	61.1	+7.9	60.3	1954
Corpus Christi, Tex	66.7	+6.4	66.2	1932
Phoenix, Ariz	61.4	+5.7	61.1	1954
Roswell, New Mex	52.2	+7.4	50.3	1954
Las Vegas, Nev	55.0	+4.6	54.1	1954
Macon, Ga	58.8	+7.3	57.3	1932
Oak Ridge, Tenn	49.1	+8.7	47.2	1949

3. The confluence which developed between the weakened (but still substantial) Alaskan ridge and the southwesterly current of tropical air from the southeast Pacific maintained a strong westerly jet across the northern tier of States. Thus cold polar Canadian air masses were largely contained.

Cold air, however, was available in quantity, judging from the thickness DN chart for the month (fig. 10). One very cold thrust did break away from the source region and enter the United States via the central Plains [11]. Several records for coldness were established at individual stations on individual days. However, considered on a monthly basis, the bulk of the cold air was contained in northwestern Canada, and a strong contrast between this air and the unusually warm conditions over the United States resulted in a very strong frontal zone along the northwestern border. This is reflected on the chart showing the frequency of occurrence of fronts over North America (fig. 11) where a maximum is indicated westward from the Great Lakes. This accounts for the near or slightly below normal temperatures observed for the month (Chart I-A) in that area. Otherwise the nation enjoyed a mild month. Along the southern border, the warm weather was unprecedented, and numerous new records were established in many areas. El Paso, Tex., for example, experienced the warmest February in 77 years' record. Other stations recording new highs for the month are listed in table 1.

It is rather unexpected that a month in which blocking played such a dominant role should be so warm over the United States. In fact, blocking is more commonly associated with cool temperature regimes to the south. However, the Baffin Bay anomaly center appears to have been too far north and the Pacific center too far west to lead to cold conditions over the United States. Of additional interest is the connection which was maintained between the former center and the mid-latitude ridge over the United States, at least in a departure from normal sense. The more usual concept associated with blocking, however, is that middle and lower latitude ridges weaken or disappear, so that no such connection maintains. This was not typical of this February nor does it typify the Februarys of the past seven years as will be discussed below.

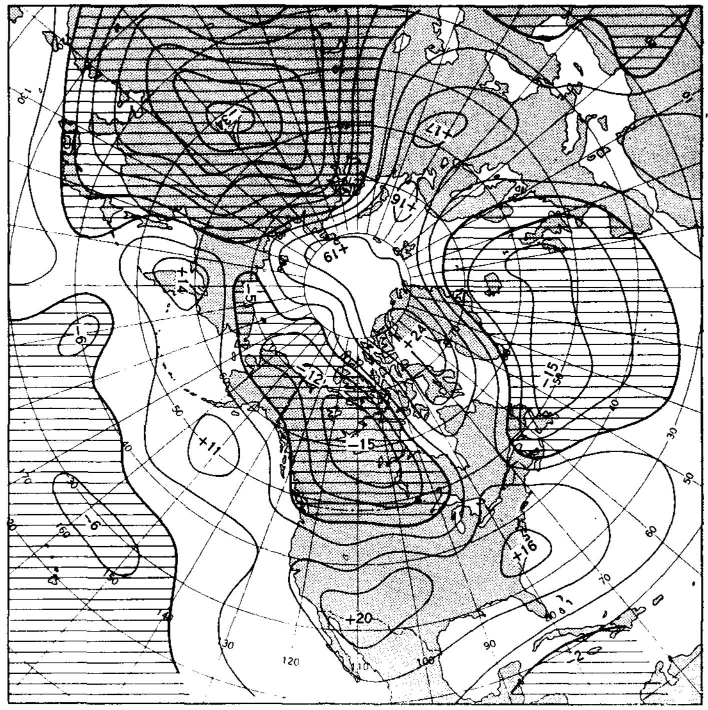


FIGURE 10.—Departure from normal of monthly mean thickness (1000–700-mb., labeled in tens of feet) for February 1957, with subnormal values hatched. The cold air in the source region of northwestern Canada was contained, and warm air predominated over the United States. Note also the extreme cold over Siberia, as contrasted to the mild regime over most of Europe.

A long-standing trend toward warm winters in the Northeast has been discussed by several authors [5, 14]. That this tendency was representative of this month is amply evident from table 2, in which mean monthly temperature departures from the new 30-year (1921–1950) normal are tabulated for the years since 1949. After 1950 not a single negative value appears and, except for that year, very warm conditions have predominated for a surprisingly long period. A composite 700-mb. chart computed for the Februarys of 1951 through 1957 (not shown) reveals that above normal heights prevailed over northeastern Canada with the maximum departure (+240 feet) centered over Greenland. Also, as mentioned in the previous paragraph, these were associated, not with negative, but with positive height anomalies over the whole of the United States. Thus, blocking in the Greenland area appears to have accompanied abnormal warmth over the United States, at least in recent Februarys.

TABLE 2.—*Mean February temperature departures from normal for selected cities in the northeastern United States (°F.)*

	1949	1950	1951	1952	1953	1954	1955	1956	1957
New York, N. Y. (LaGuardia Field)	+6.3	−0.2	+4.0	+3.9	+6.2	+7.6	+2.6	+4.5	+5.2
Washington, D. C	+6.7	+1.6	+1.5	+4.0	+5.5	+6.4	+0.7	+4.0	+4.3
Boston, Mass	+5.2	−1.2	+5.5	+3.3	+5.8	+7.2	+2.8	+3.3	+5.5
Caribou, Maine	+0.9	−1.7	+5.4	+7.0	+7.6	+11.4	+5.3	+3.5	+5.7
Buffalo, N. Y	+7.1	+0.1	+2.7	+4.4	+6.0	+8.4	+3.2	+5.3	+6.1
Elkins, W. Va	+4.7	+1.8	+1.0	+2.8	+1.8	+3.8	+1.0	+5.3	+5.0
Lynchburg, Va	+6.2	+0.4	+0.1	+2.2	+3.0	+4.6	+0.1	+2.5	+3.8

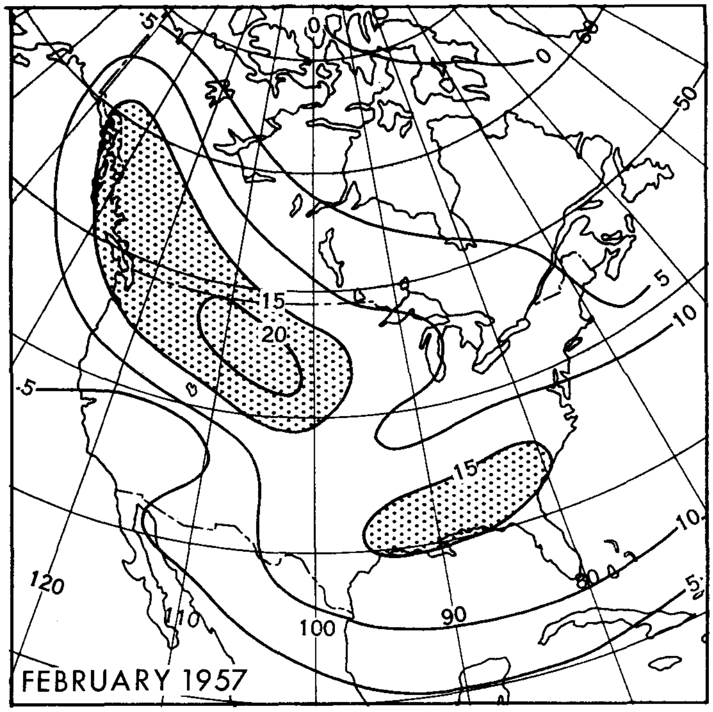


FIGURE 11.—Number of days in February 1957 with fronts of any type (within squares with sides approximately 430 nautical miles). Frontal positions taken from *Daily Weather Map*, 1:30 p. m. EST. Note high frequency of fronts in the Southeast and in the northern tier of States from the Great Lakes westward.

6. PRECIPITATION IN THE UNITED STATES

During February heaviest amounts of precipitation occurred along an axis extending from Texas east-northeastward to the Atlantic Coast. Torrential rains were recorded in the southern Appalachians, at times reaching flood proportions. This storminess began toward the end of January and resulted in severe flooding in the mountainous regions of West Virginia, Virginia, Kentucky, and Tennessee, giving rise to river crests which caused minor inundations as they moved downstream into northern Mississippi, Alabama, and Georgia. Further rains occurred in approximately the same area during the second week of February, resulting in additional flooding—this time along the Monongahela and Little Kanawha Rivers in the lowlands of southern Pennsylvania, southern Ohio, West Virginia, and Kentucky.

The precipitation pattern was associated with the confluence zone [4] apparent in the southeastern United States from the mean chart for the month (fig. 1), a feature particularly pronounced during the first portion of the month (fig. 3A). Southerly flow from the Gulf of Mexico insured an adequate supply of moist, tropical air. The region was one of frequent frontal activity (fig. 11), though it is of interest to note that there is little or no indication of a frontal temperature contrast on the mean thickness DN chart for the month (fig. 10), the principal thermal discontinuity remaining well to the north along the northern border. An interesting series of these storms is discussed by J. Badner and M. A. Johnson elsewhere in this issue.

Rainfall in Texas, Oklahoma, and in the Southwest was particularly welcome since it afforded some alleviation of the drought in those areas. Rainfall on a 6-month basis was still deficient [12] however, over much of the south-central Plains where additional rains were needed to consolidate the gains made and to bring soil moisture content up to normal levels. The central Plains States continued to be badly in need of rain, and the light precipitation of February in those areas made only a slight contribution to overcoming the long-standing moisture deficit. Copious precipitation also fell in the western United States and was fairly evenly distributed throughout the month. One particularly intense storm, which entered the west coast on the 23d, resulted in excessive rains and local flooding in northern California. These warm rains resulted from the release of moisture from warm moist air from the tropical Pacific.

7. HAWAIIAN ISLANDS RAINFALL

Cool and rainy weather in the Hawaiian Islands, a frequent concomitant of blocking in the Gulf of Alaska [9] which dominated the January pattern [10], continued into the first half of February. Two periods of kona weather occurred, though neither approximated the intensity of the January storms. However, as the pattern changed after mid-month and westerly replaced easterly flow with respect to normal (fig. 3), rainfall diminished sharply. Thus, at Lihue Airport, Kauai, the rainfall dropped from 6.99 in. to 0.10 in. from the first to the last half of the month, and at Honolulu Airport the decrease was from 2.41 in. to 0.24 in. Also of interest in this connection is the fact that the mean trough lay east of the Islands, a factor which was also unfavorable for precipitation. This is a frequent trough position in February owing to the normal speed-up of low-latitude westerlies and the fairly stationary position of the Asiatic coastal trough [8].

8. SIBERIAN WEATHER

The mild conditions which prevailed over Europe during February have already been mentioned. In contrast, Siberia was extremely cold, even for that normally frigid climate. This is confirmed by the thickness DN chart (fig. 10) which reveals values markedly lower than normal, with a central departure of −380 feet. The related circulation pattern suggests that this anomalous cold was a function of the intense blocking surge, as has already been discussed, which became firmly established in the far north over the Laptev Sea during the month. Thus, strong easterly flow with regard to normal was the rule over the whole of Siberia, both for the complete month (fig. 1) and its individual halves (fig. 3A, B). This provided little or no opportunity for maritime air to penetrate into the area from the Atlantic, and the resultant situation permitted a deep and very cold pool of continental air to be manufactured. This pattern is in sharp contrast to February 1956 [1] in which the severe cold was confined to Europe and Eurasia, and relatively mild conditions prevailed over northeastern Siberia.

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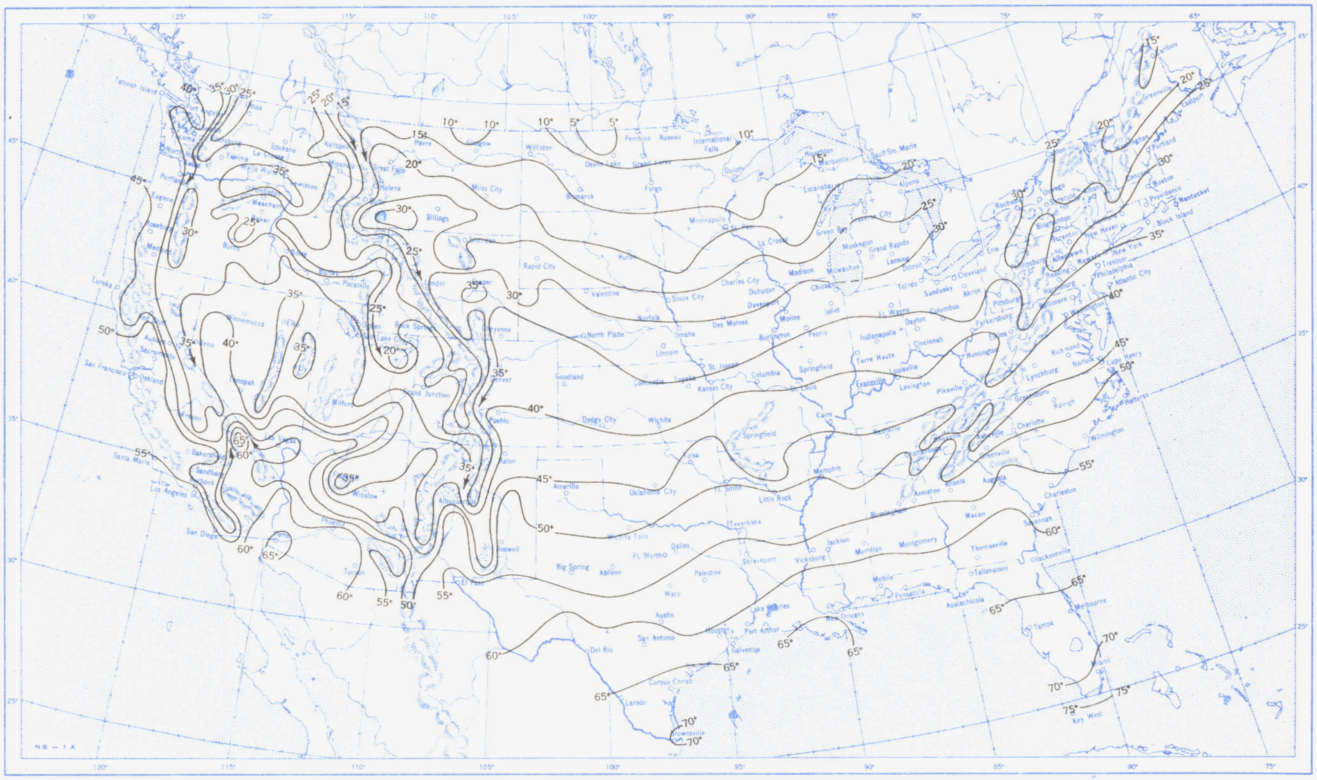
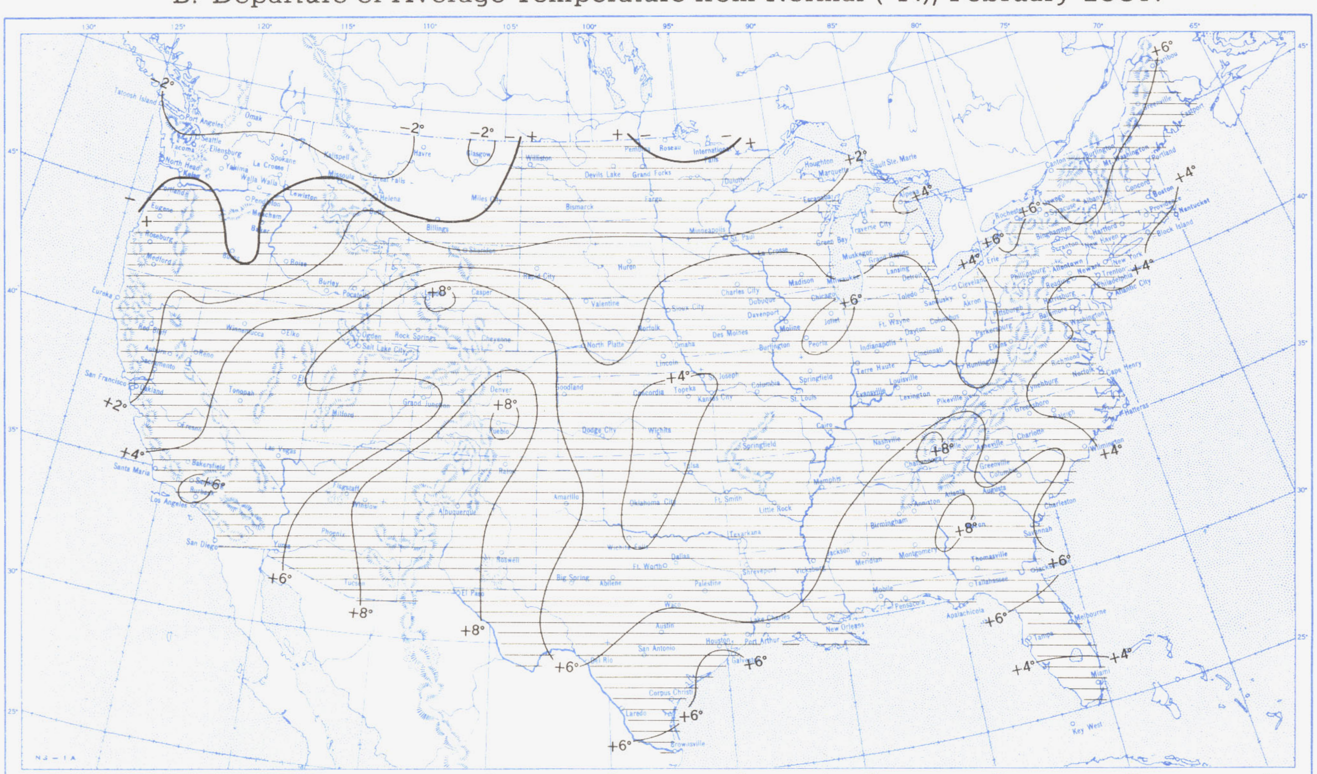
Chart I. A. Average Temperature (°F.) at Surface, February 1957.

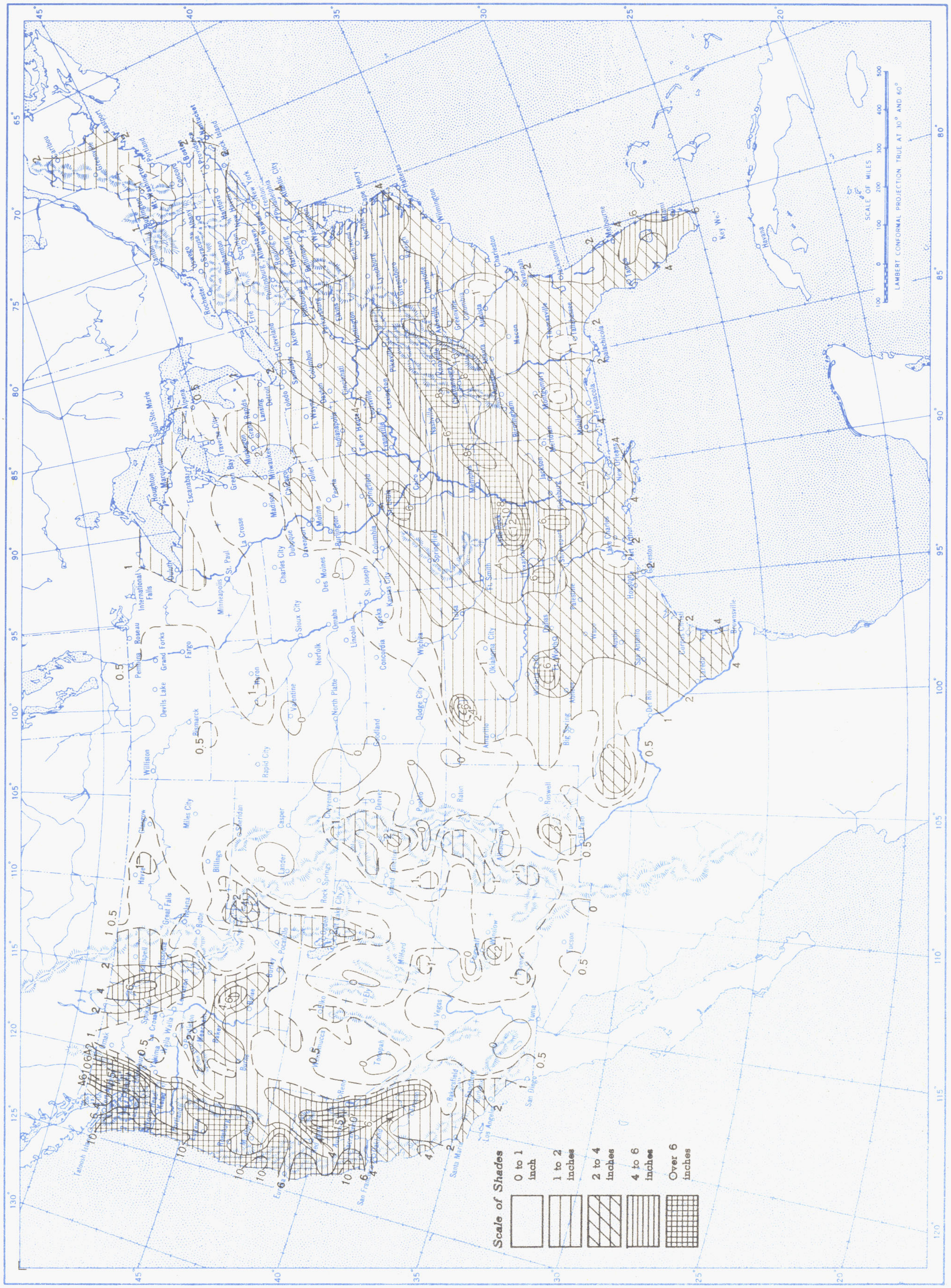


B. Departure of Average Temperature from Normal (°F.), February 1957.



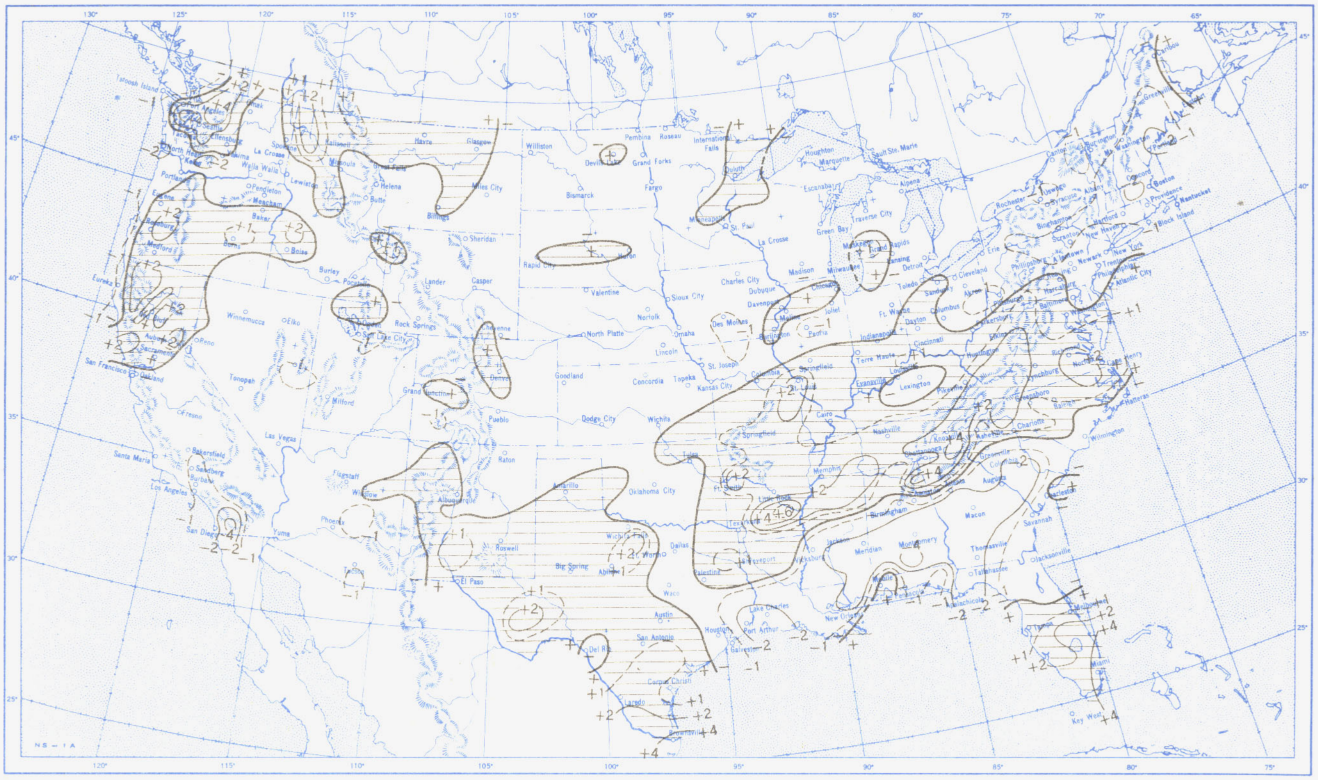
A. Based on reports from over 900 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Departures from normal are based on the 30-yr. normals (1921-50) for Weather Bureau stations and on means of 25 years or more (mostly 1931-55) for cooperative stations.

Chart II. Total Precipitation (Inches), February 1957.

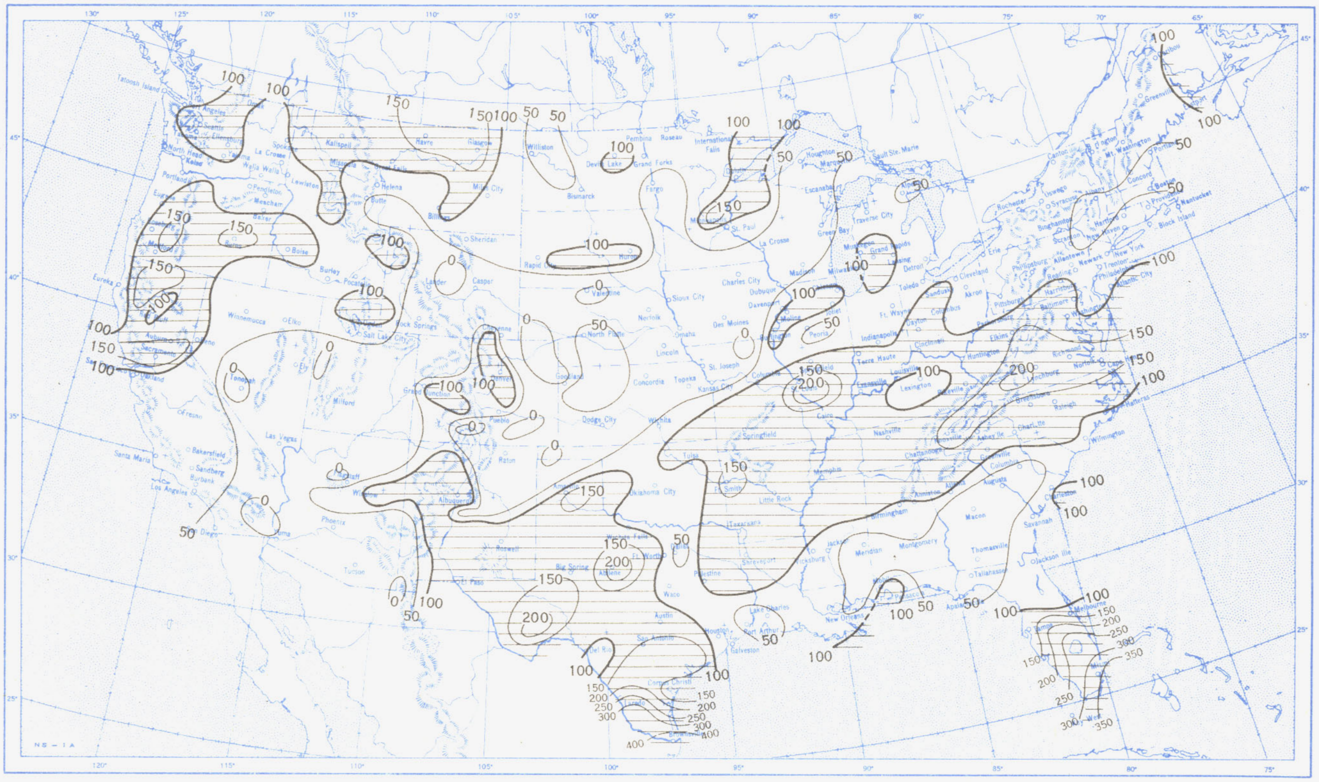


Based on daily precipitation records at about 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), February 1957.



B. Percentage of Normal Precipitation, February 1957.

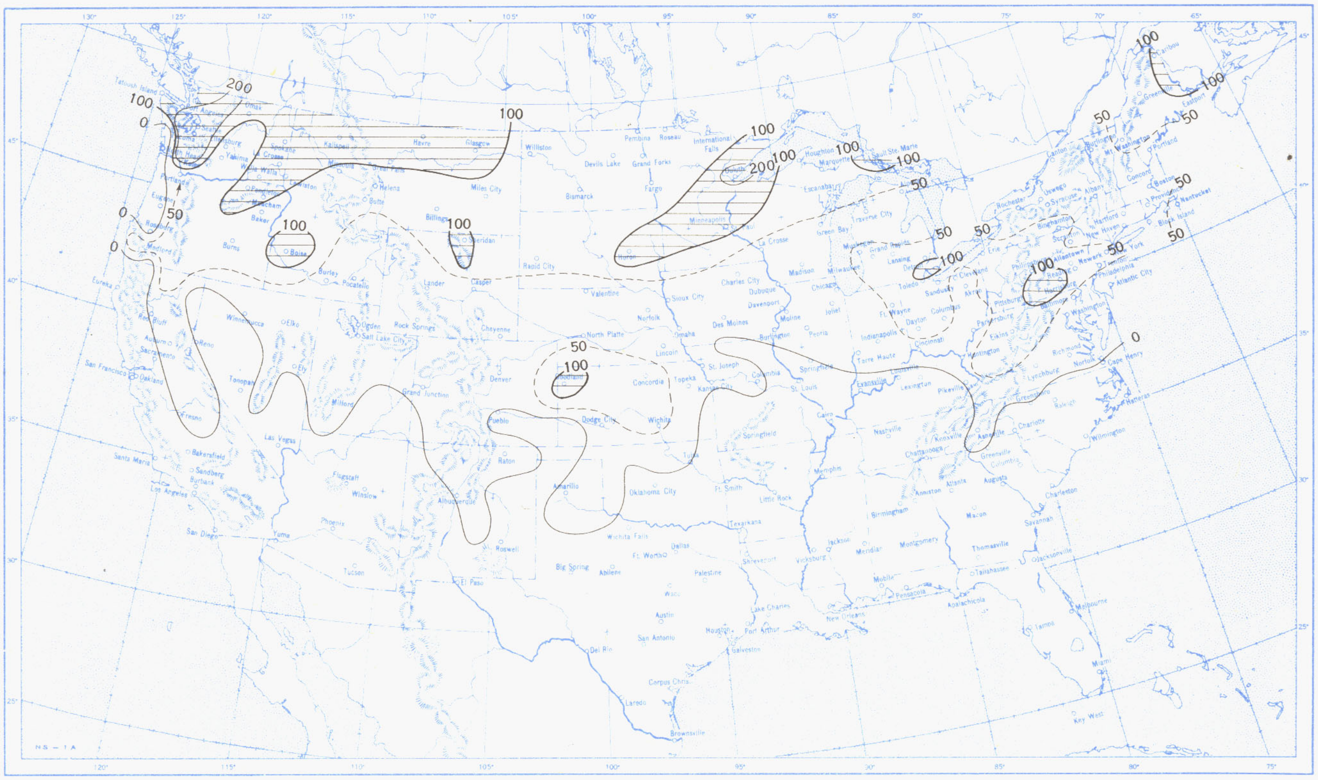


Normal monthly precipitation amounts are computed from the records for 1921-50 for Weather Bureau stations and from records of 25 years or more (mostly 1931-55) for cooperative stations.

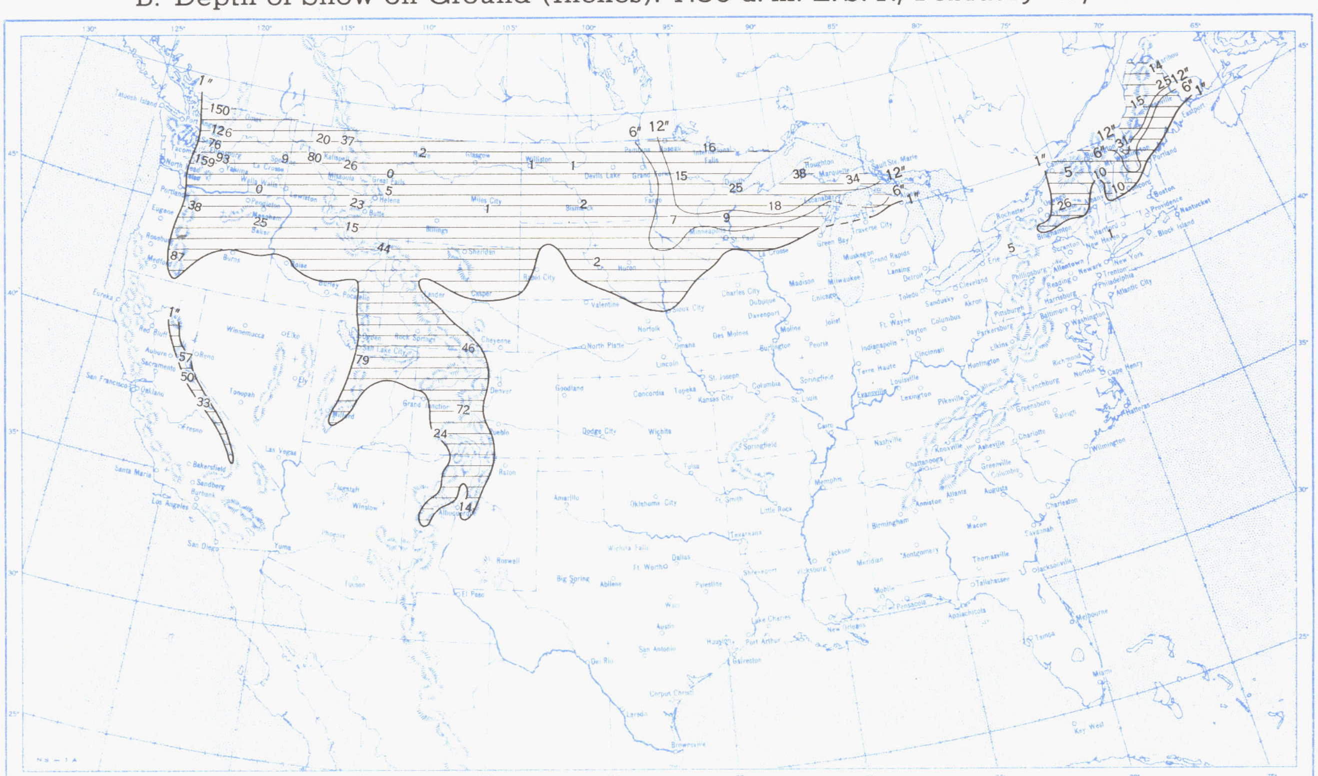
Chart IV. Total Snowfall (Inches), February 1957.

This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

Chart V. A. Percentage of Normal Snowfall, February 1957.

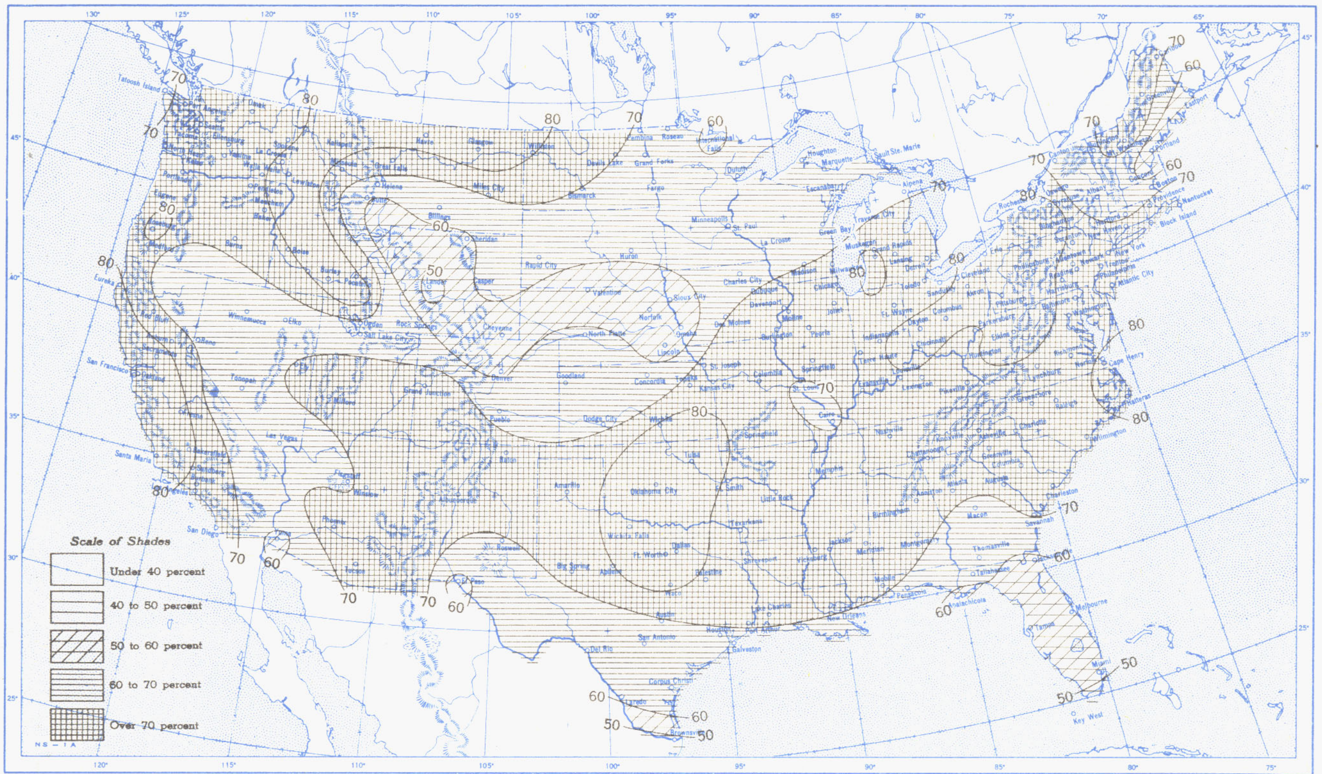


B. Depth of Snow on Ground (Inches). 7:30 a. m. E. S. T., February 25, 1957.

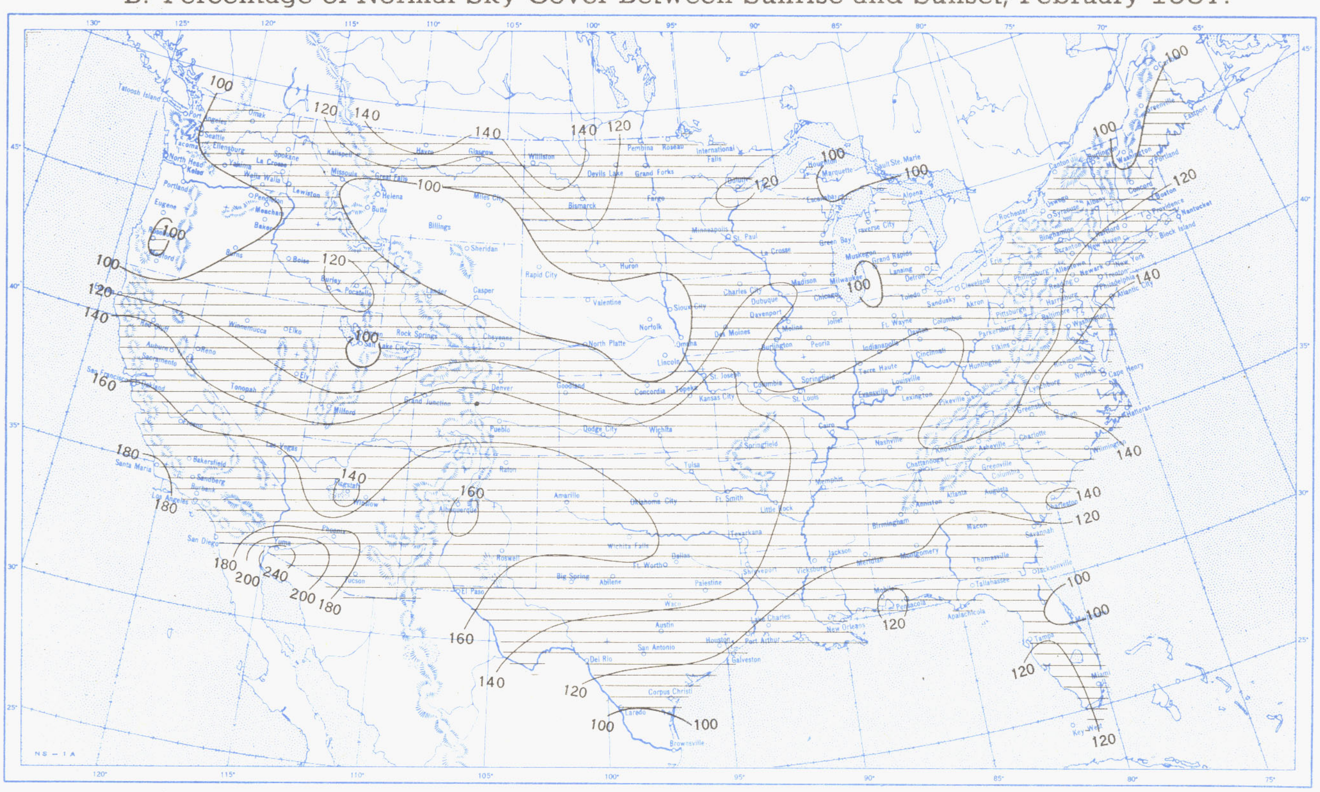


A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record. B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Monday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, February 1957.

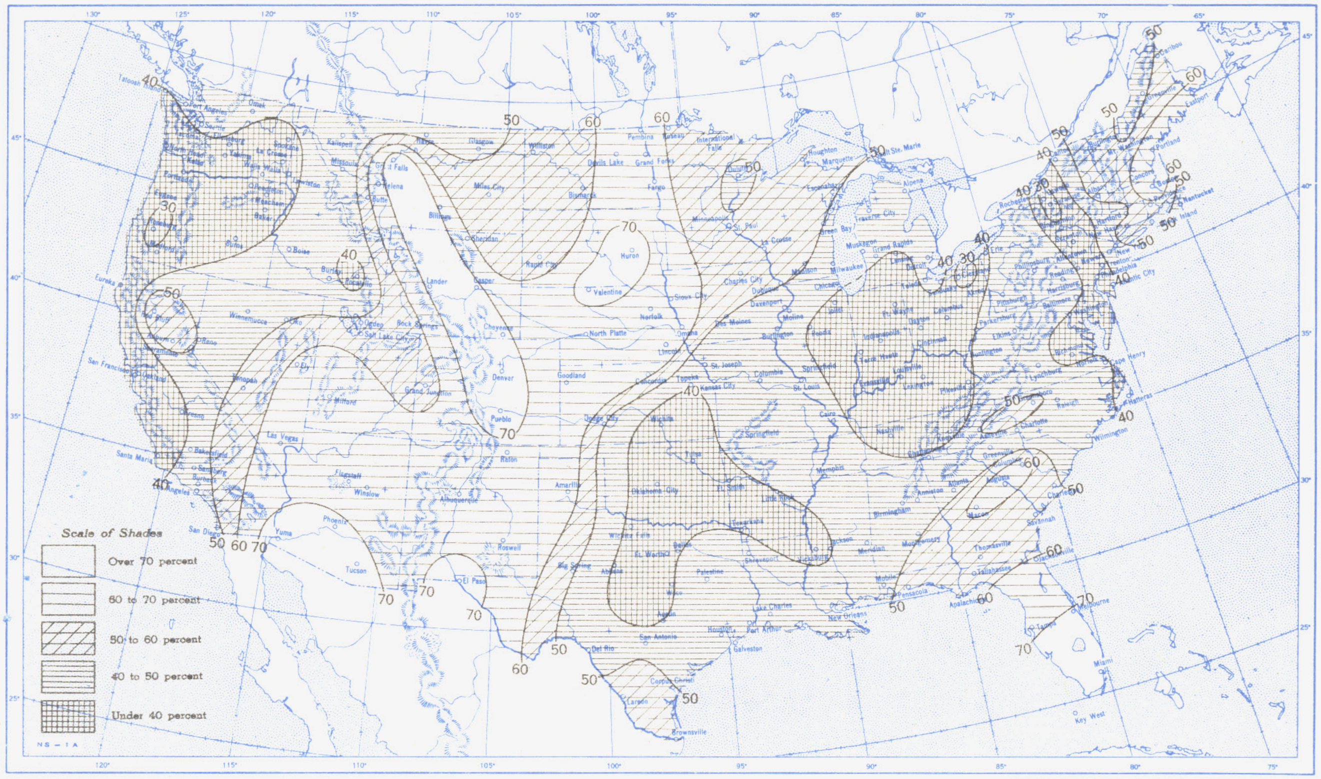


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, February 1957.

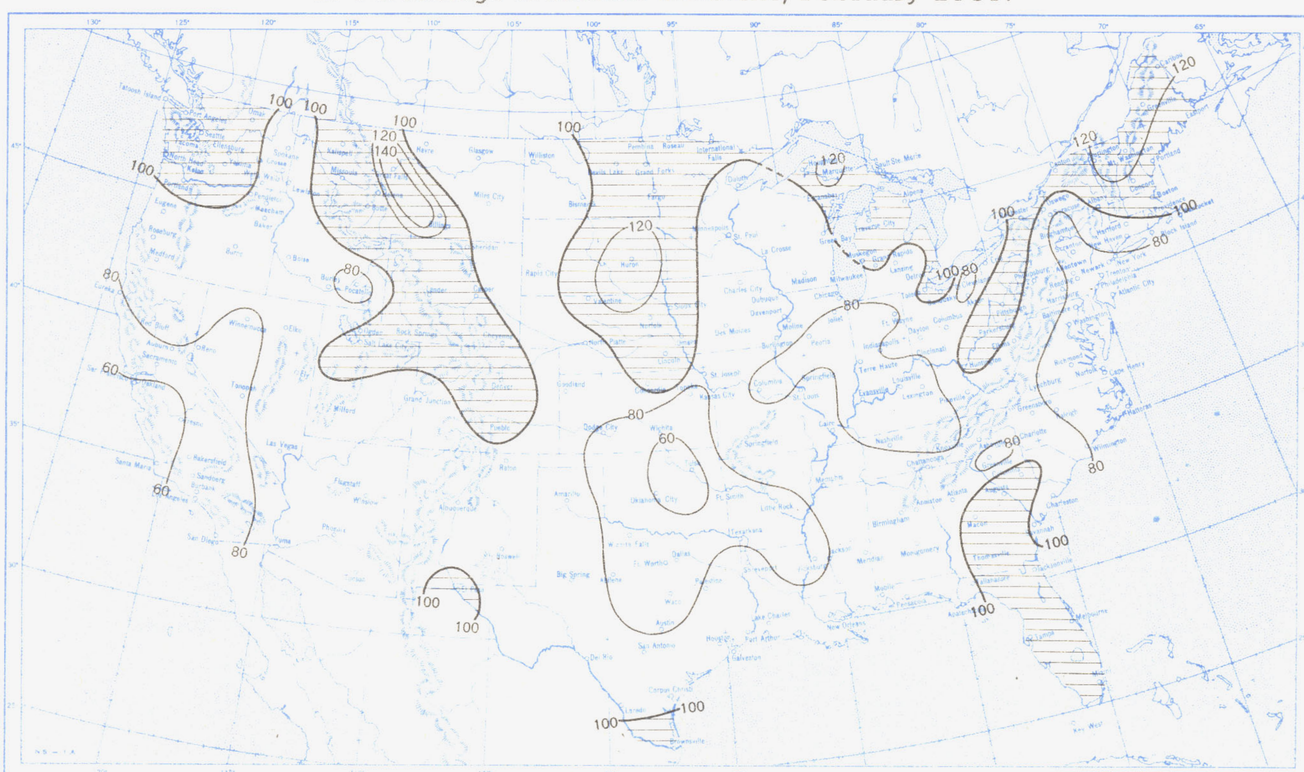


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, February 1957.



B. Percentage of Normal Sunshine, February 1957.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, February 1957. Inset: Percentage of Mean Daily Solar Radiation, February 1957. (Mean based on period 1951-55.)

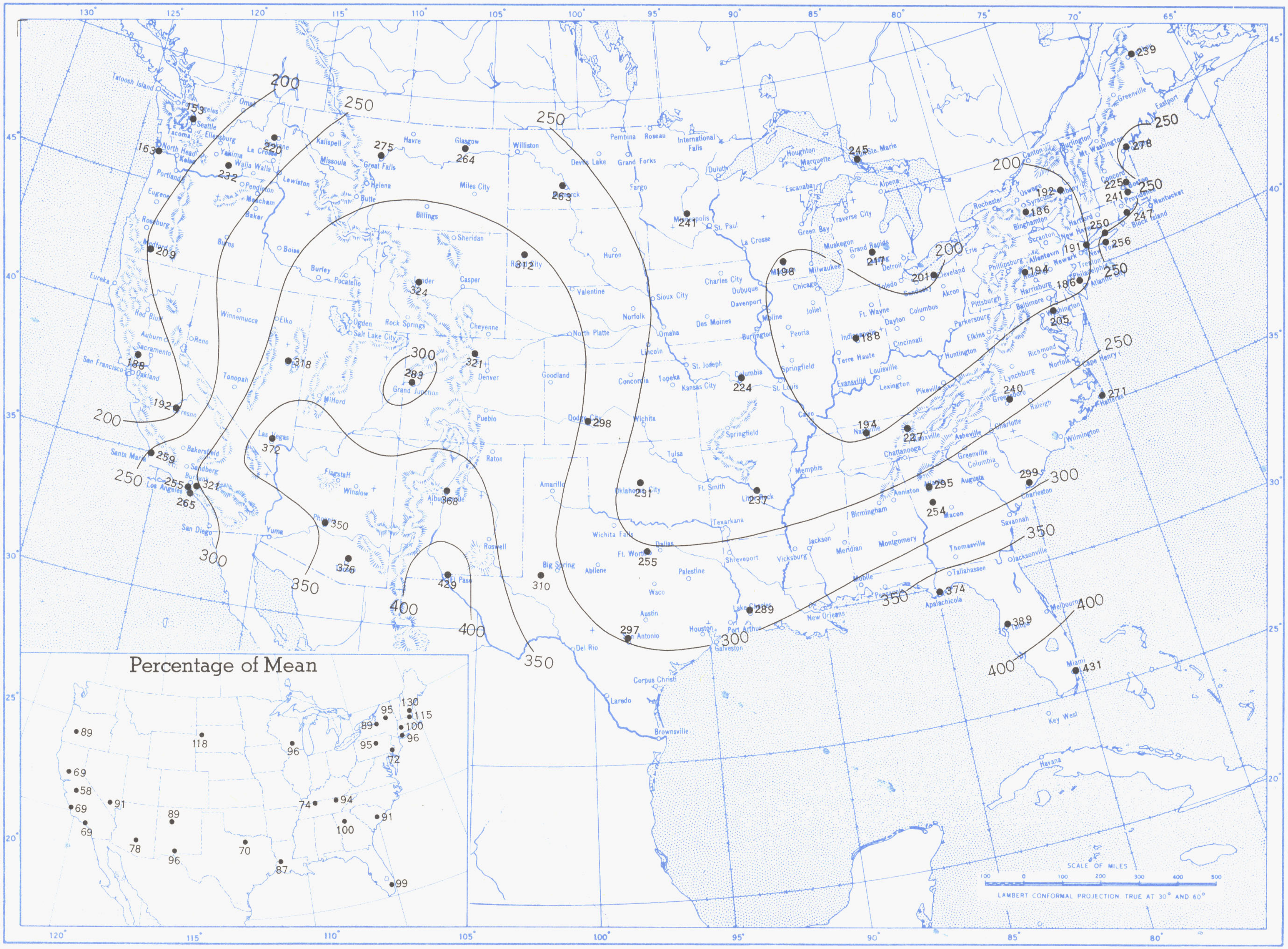
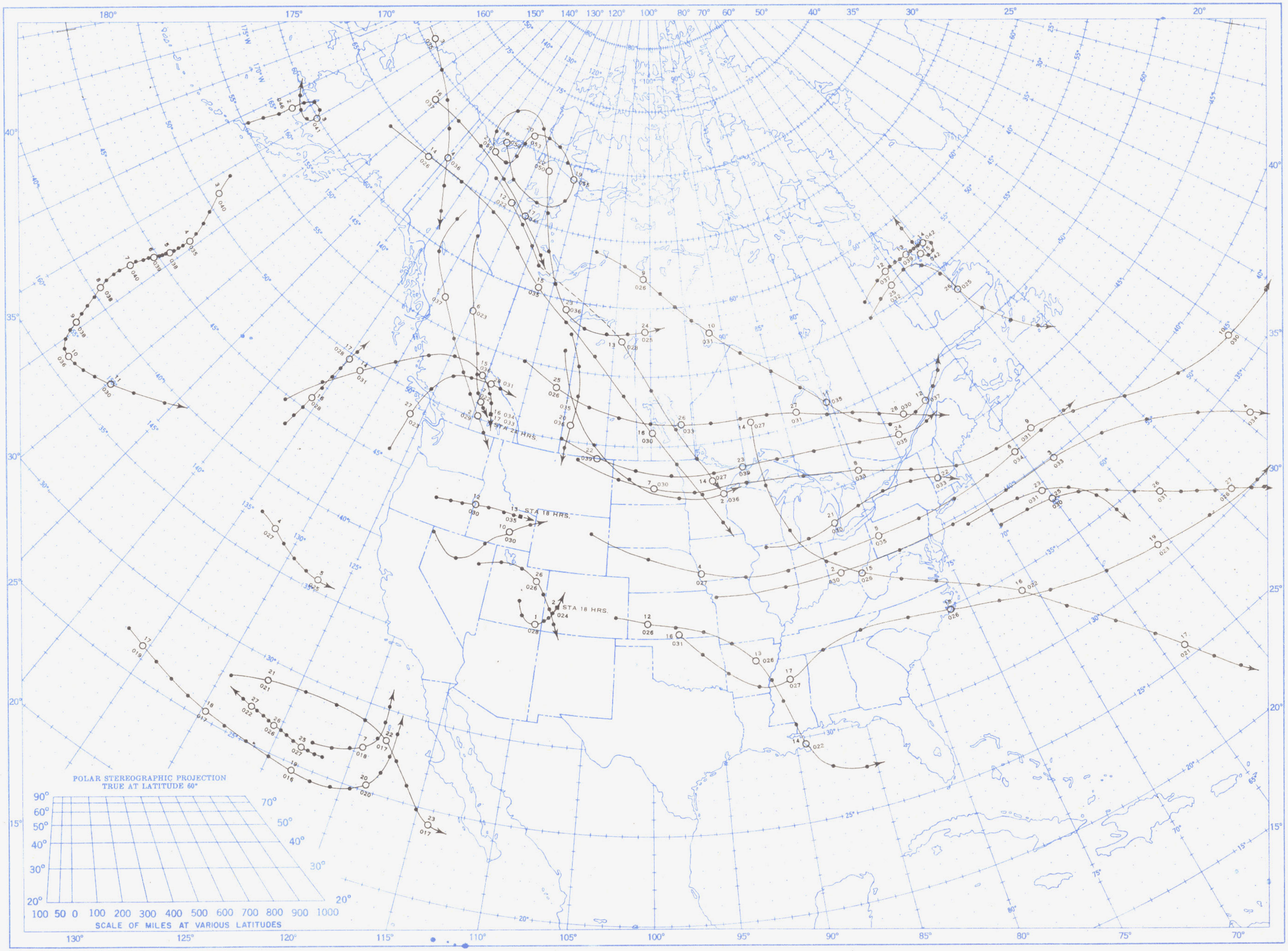


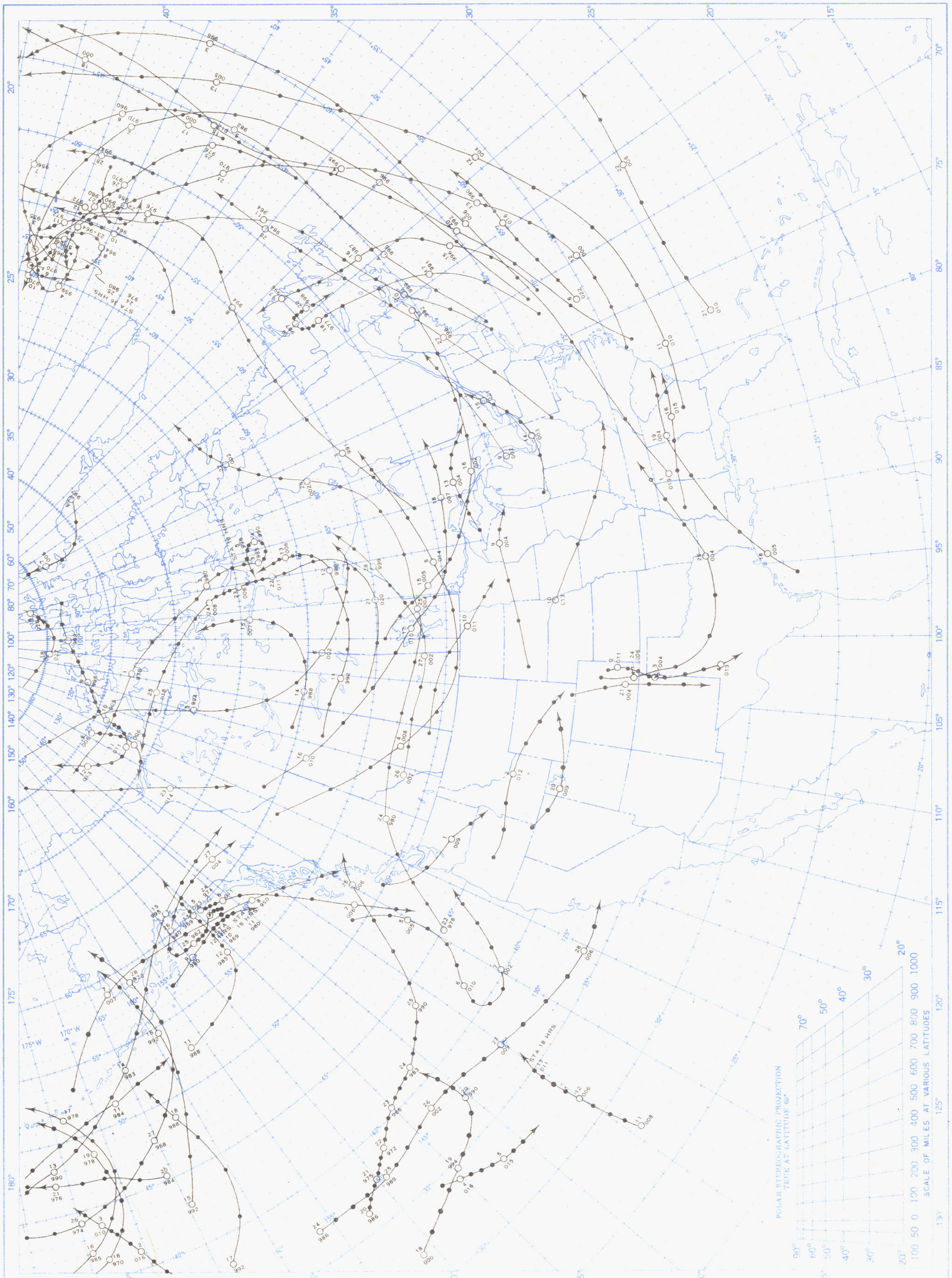
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown. The inset shows the percentage of the mean based on the period 1951-55.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, February 1957.



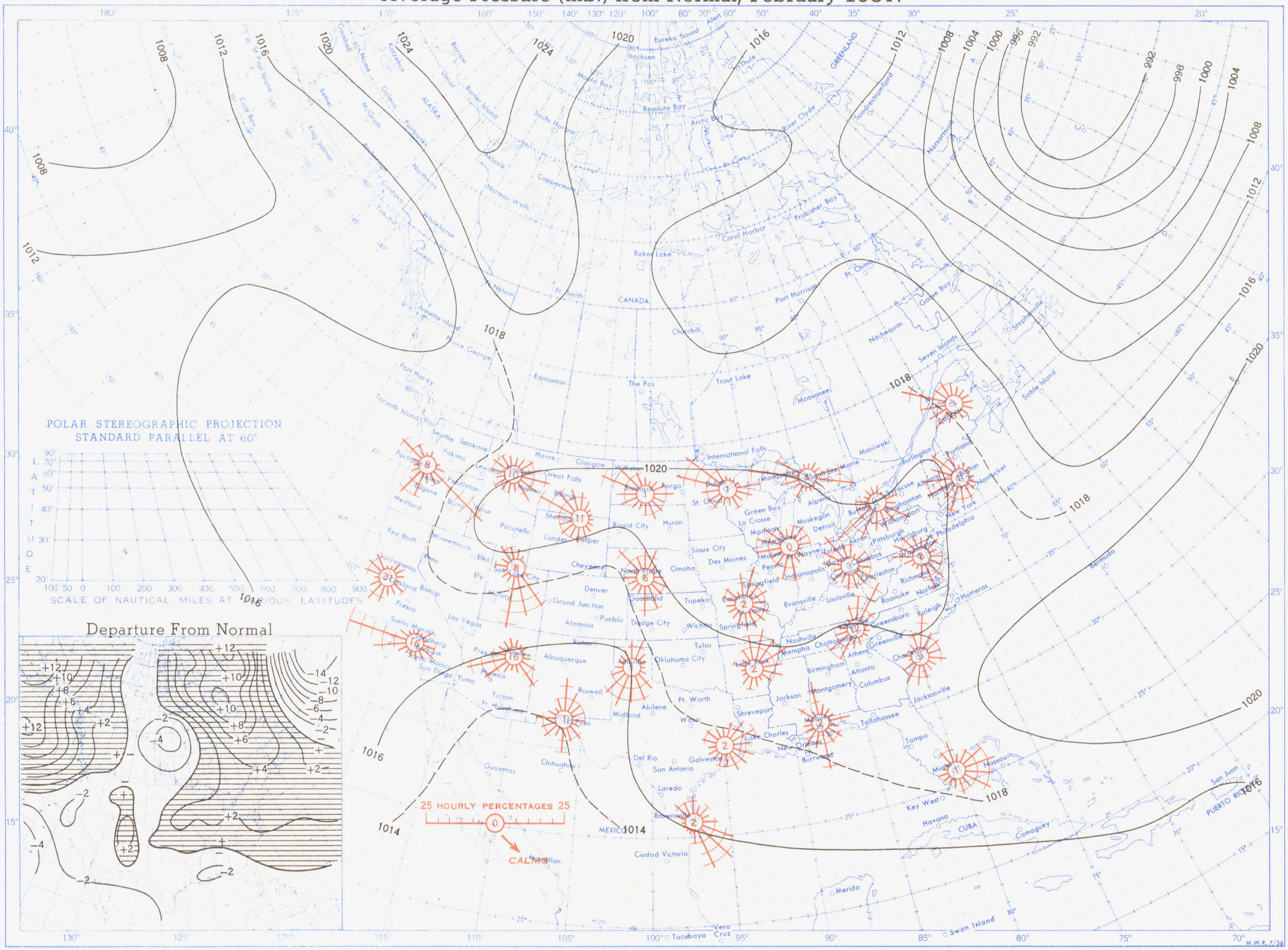
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, February 1957.



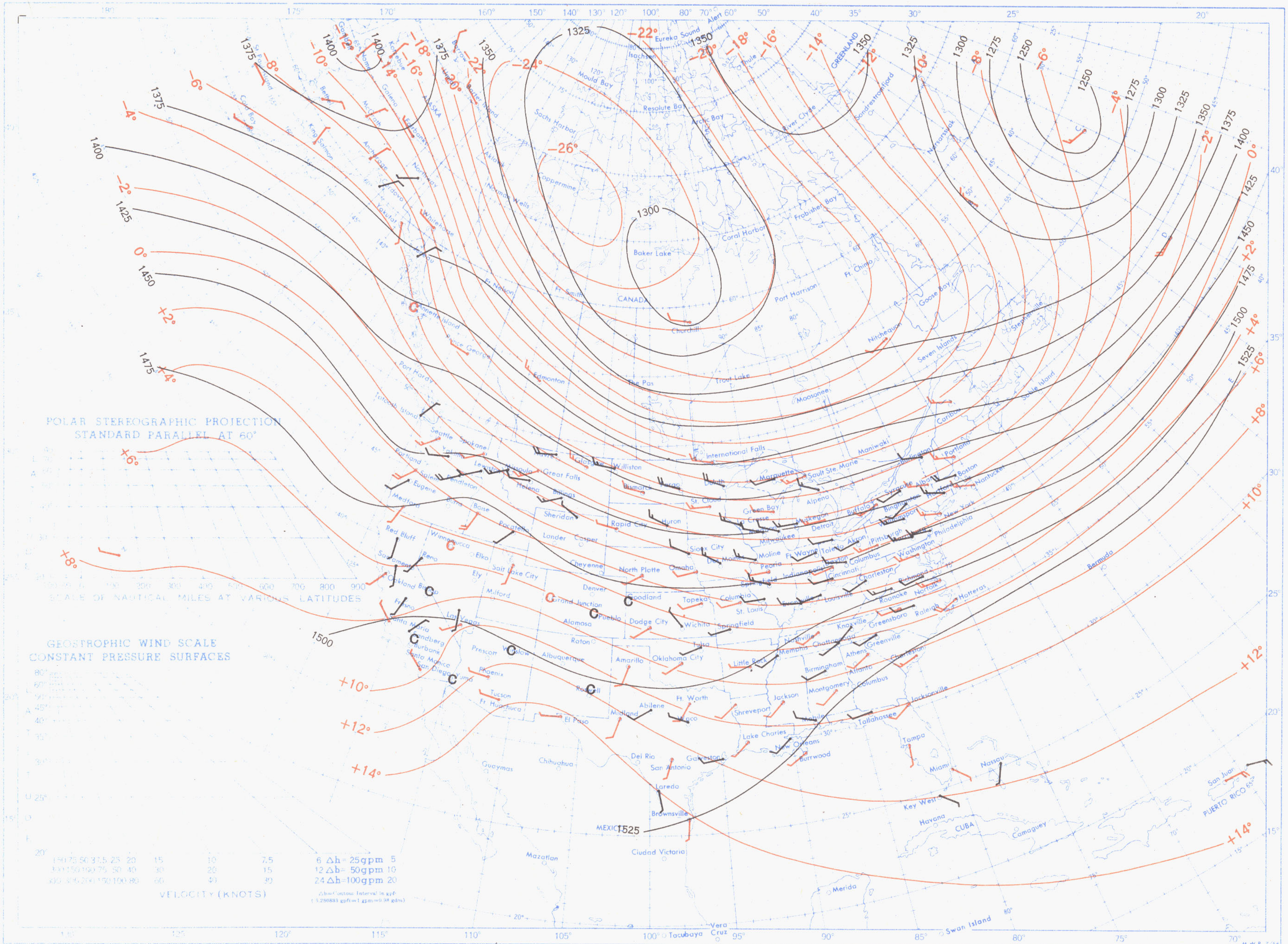
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, February 1957. Inset: Departure of Average Pressure (mb.) from Normal, February 1957.



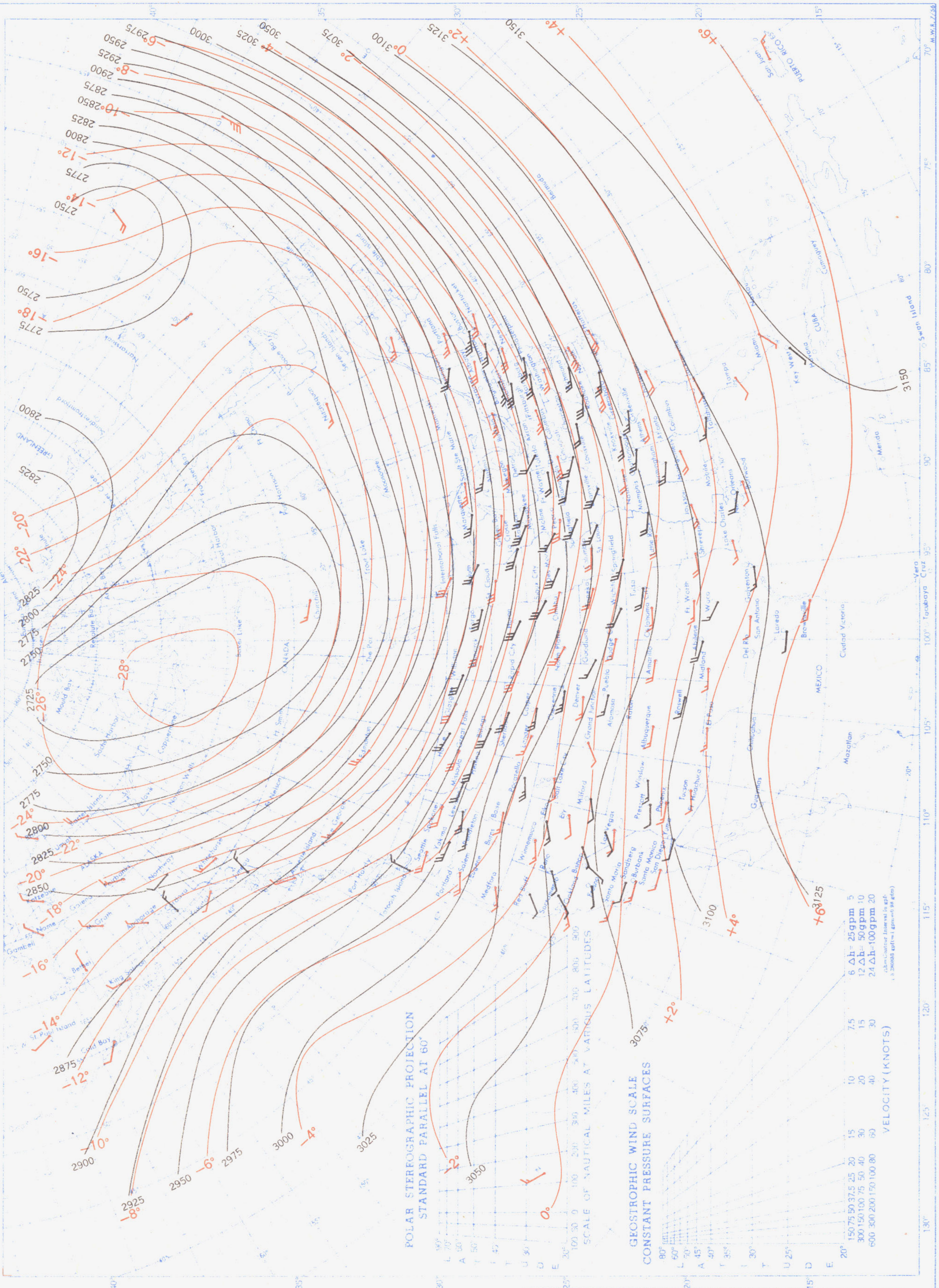
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. 850-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



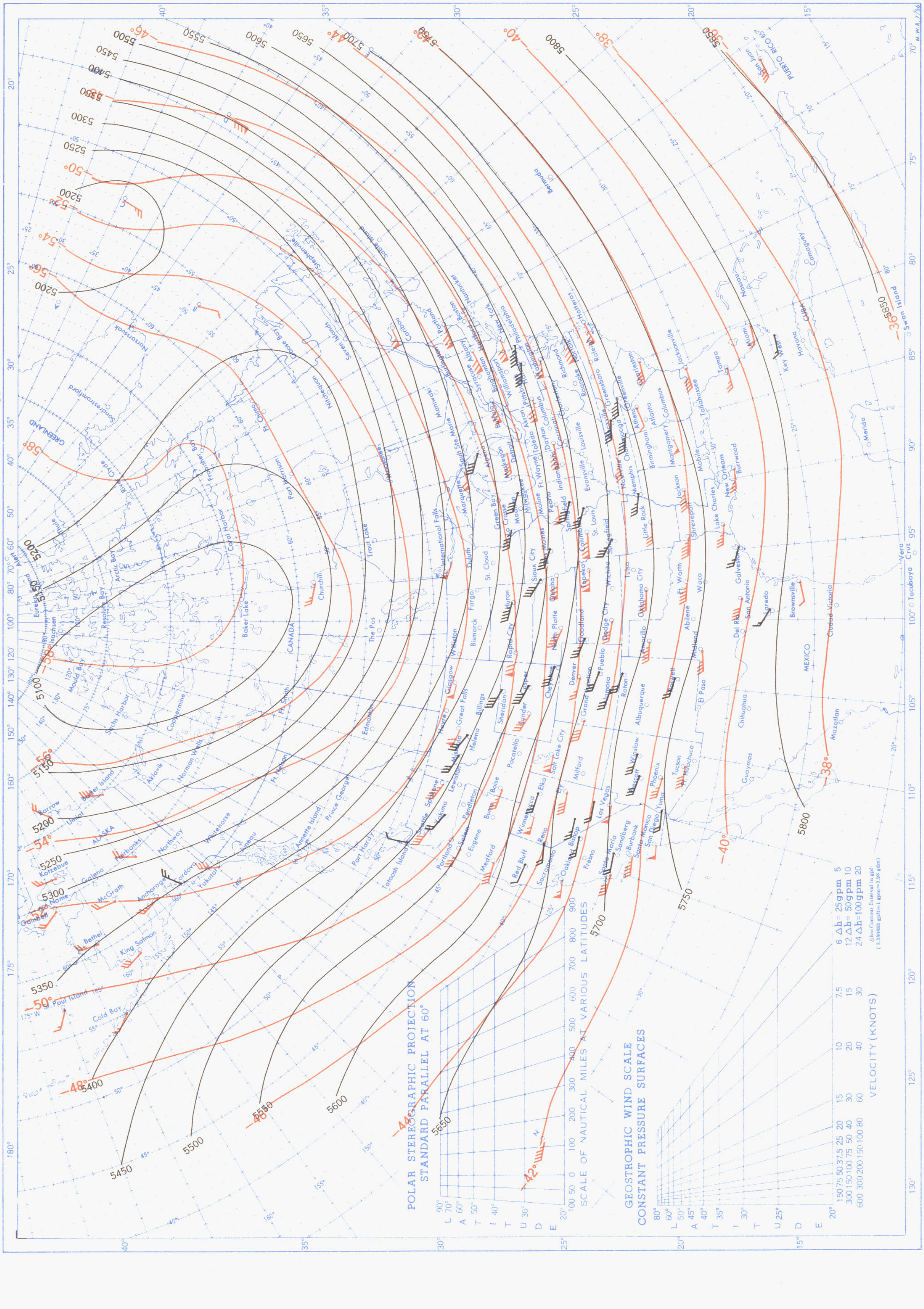
Height in geopotential meters (1 g.p.m. = 0.98 dynamic meters). Temperature in °C. Wind speed in knots; flag represents 50 knots, full feather 10 knots, and half feather 5 knots. Winds shown in red are based on rawins taken at the indicated pressure surface and time. Those in black are based on pibals taken at 2100 GMT and are for the nearest standard height level.

Chart XIII. 700-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



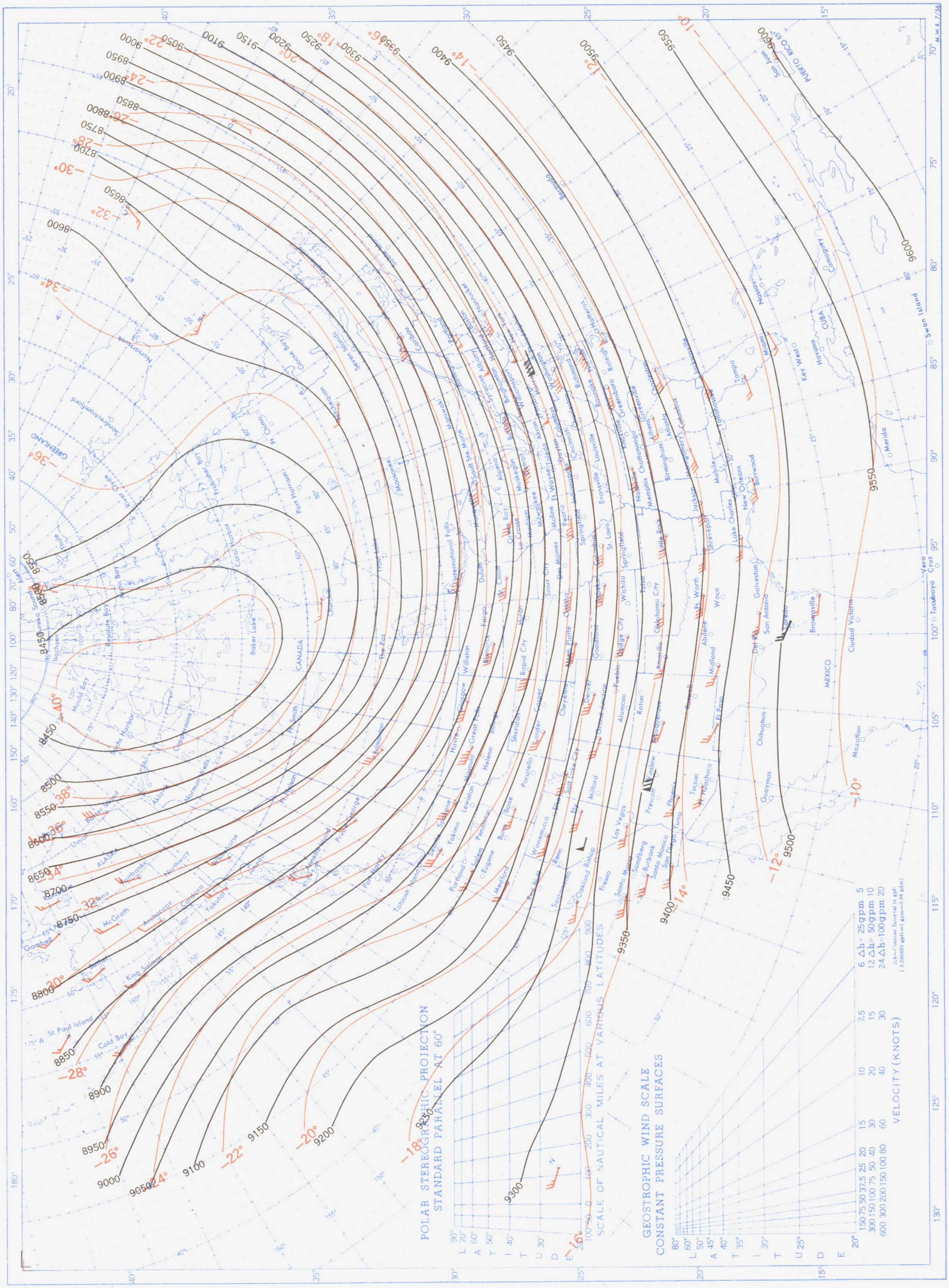
See Chart XII for explanation of map.

Chart XIV. 500-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



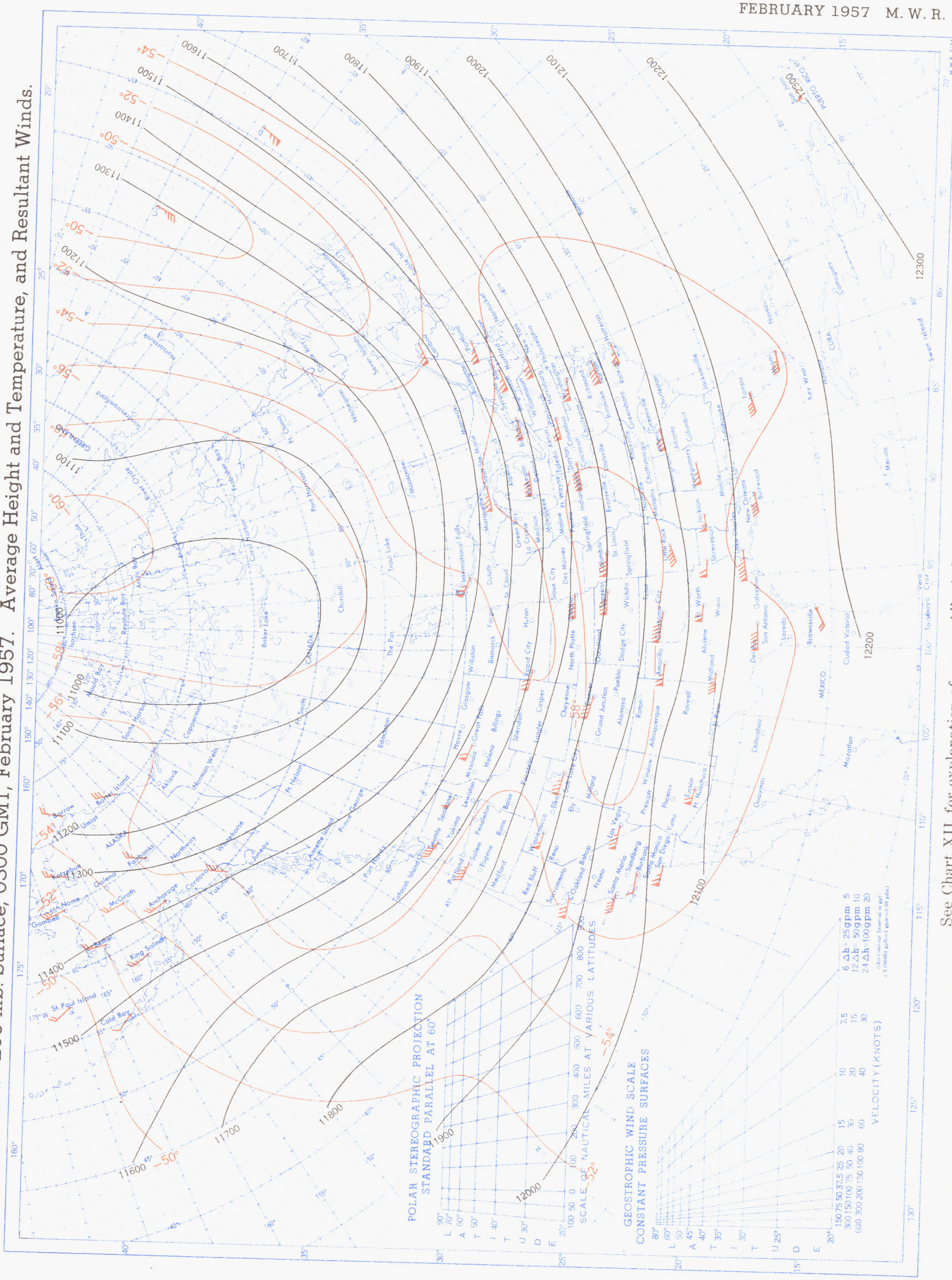
See Chart XII for explanation of map.

Chart XV. 300-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



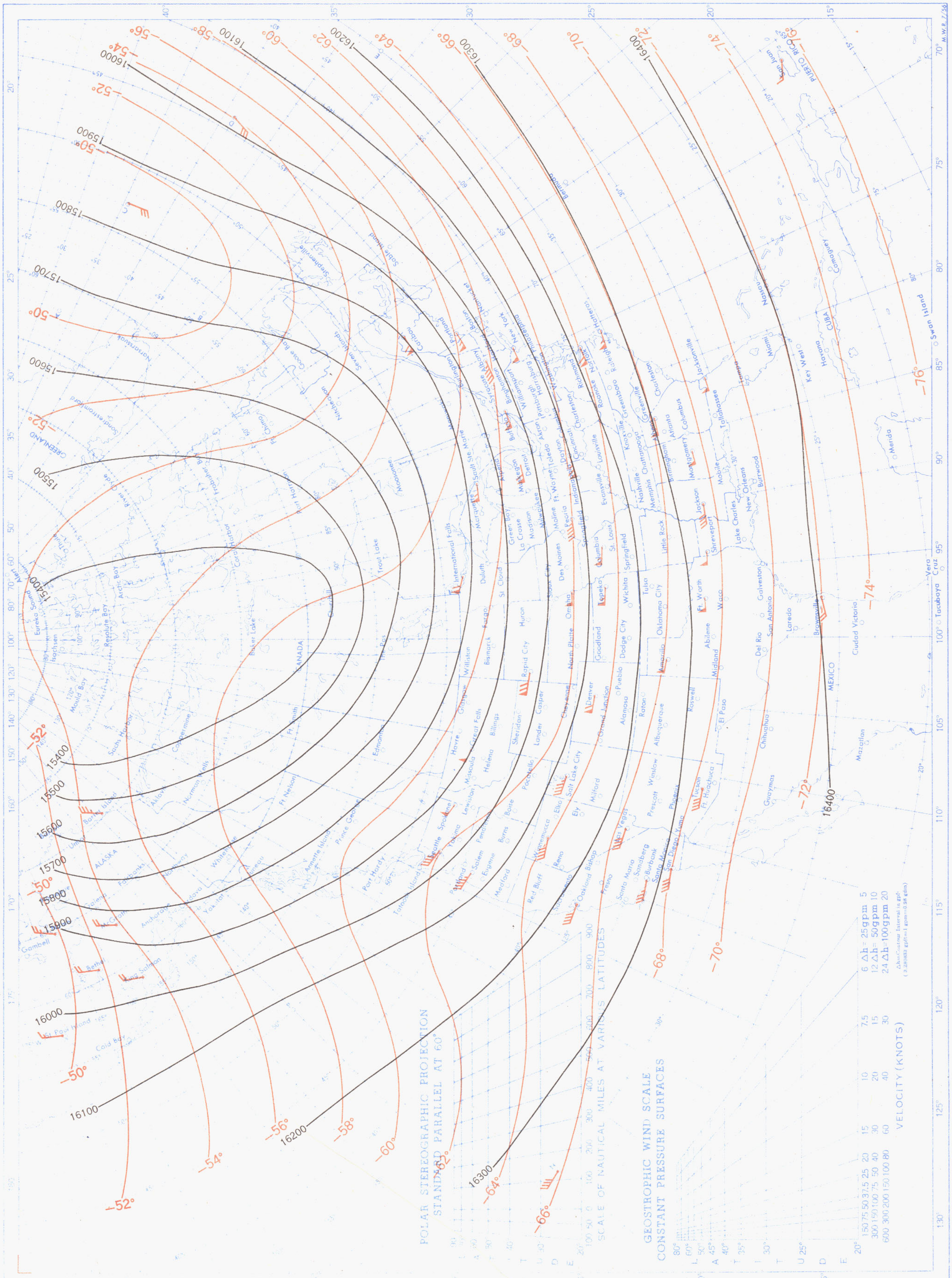
See Chart XII for explanation of map.

Chart XVI. 200-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map. All winds are from rawin reports.

Chart XVII. 100-mb. Surface, 0300 GMT, February 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map. All winds are from rawin reports.